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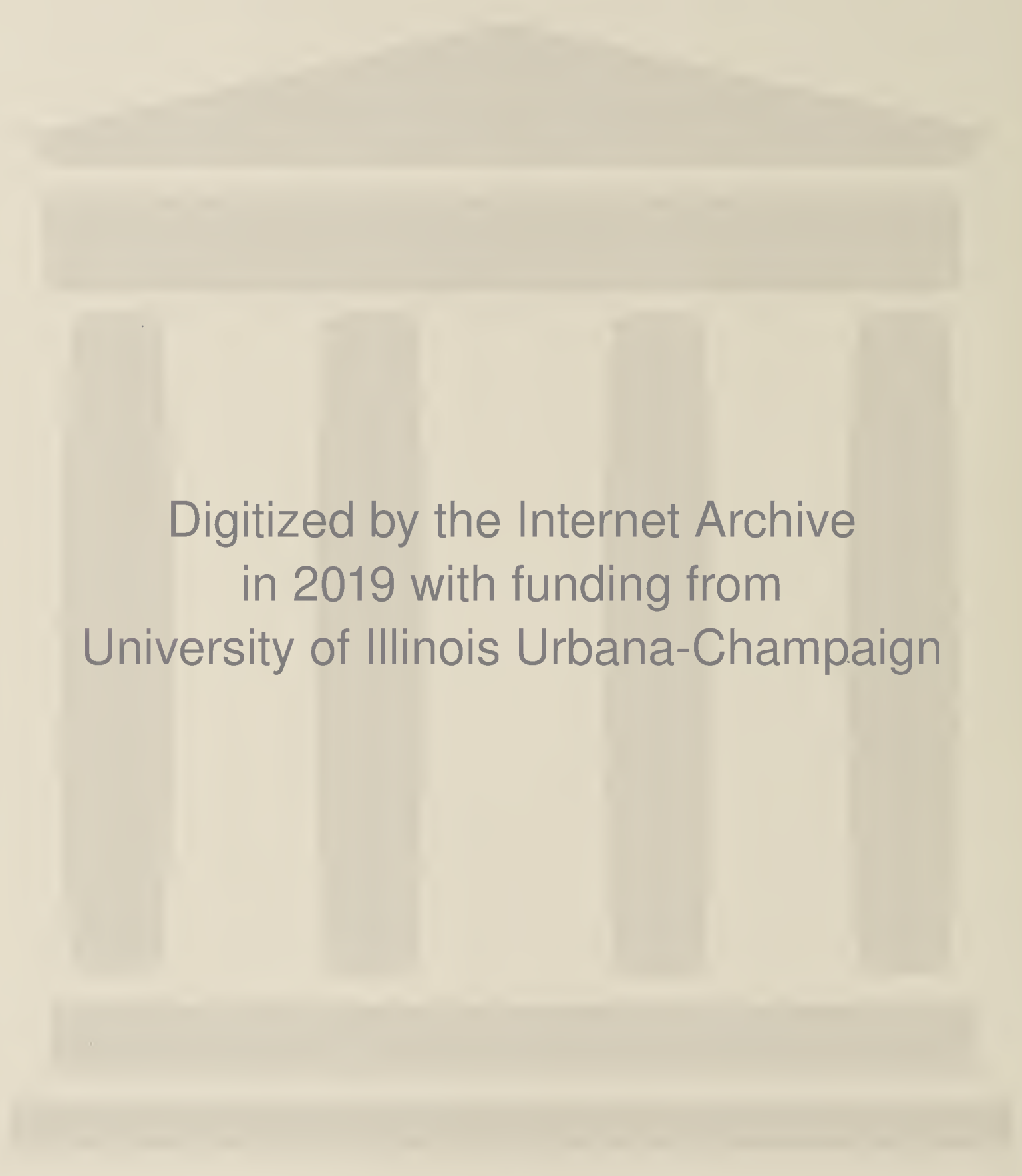
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The pages which are missing were removed because they are advertisements



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CEMENT

.....AND.....

ENGINEERING NEWS



CHICAGO'S FIRST ABSOLUTELY FIRE-PROOF BUILDING.

The John Drueker Warehouses designed to carry the heaviest loads of any building in the city, chiefly sugar stocks, to be built at 111-121 Canal Street, for John Drueker, Esq. Cost, \$300,000. Frank B. Abbott, Architect, 225 Dearborn Street, Chicago.

A sixteen story concrete building with a back-bone and ribs of steel, in the construction of which there is not a foot of lumber or a day's carpenter work. The structural steel members of this building are protected against the action of fire or rust under all known conditions, cinder concrete being the essential material, as all floors and roof will be made wholly of concrete; the columns will be enveloped in concrete and all exposed surfaces except the outside wall surfaces will be concrete; this concrete being a cinder concrete prepared under a process devised by the architect, on which the government has granted a patent. Full details of construction will be given in the near future.

THE CONSTITUTION OF HYDRAULIC CEMENTS.

BY SPENCER B. NEWBERRY AND W. B. NEWBERRY.

Read before the New York Section of the Society of Chemical Industry, October 22, 1897.

(Continued from page 84.)

4th. Effect of Alkalies.

Most writers on the cement industry have assumed that alkalies, potash and soda, play an important part in bringing about the combination of lime with silica and alumina, and the artificial addition of alkalies to materials deficient in them is often recommended. The writers' experience has been, however, that no advantage results from this addition, and Feichtinger states the same. The foregoing experiments show that pure silica, alumina and lime, free from alkalies, combine readily to produce well-sintered clinker, and that the fusibility of the clinker depends chiefly on the proportion of alumina or iron oxide present. It thus appears unlikely that alkalies have any important action.

In order to test the effect of soda on the combination of silica and lime, two mixtures were prepared according to the following formulas.

1. $3\text{CaO} \cdot \text{SiO}_2 + \text{Na}_2\text{O}$.
2. $3\text{CaO} \cdot \text{SiO}_2 + \text{Na}_2\text{SiO}_3$.

Five per cent. soda was taken in both cases.

The results were as follows:

1. Soda largely volatilized. Clinker soft, light, infusible. Powder heated strongly with water. Pat swelled and cracked before placing in water. Hot test, swelled, soft.
2. Clinker soft, light, infusible. Powder did not heat with water. Pat set fairly; swelled and cracked after two days in water.

It is interesting and rather surprising to note that while the tri-calcium silicate, $3\text{CaO} \cdot \text{SiO}_2$, proved to be of constant volume, though of feeble hardening properties, the same with the addition of sodium silicate gave a product which swelled and cracked.

It appears from the above experiments that soda is incapable of assisting in the combination of silica with high proportions of lime.

5th. Effect of Magnesia.

The question of the influence of magnesia in Portland cement has been studied by many chemists, and is now undergoing careful investigation by the Association of German Portland Cement Manufacturers. Several eminent authorities hold that the presence of considerable percentages of magnesia causes cement to expand and crack after long periods. The most thorough work on this subject is doubtless that of R. Dykerhoff, presented to the German Association in 1895. According to Dykerhoff's experiments, more than 4 per cent. of magnesia, whether added to a nor-

mal mixture or substituted for an equivalent amount of lime, causes a steady falling off in the strength of the resulting cement. Actual cracking was observed only with 8 per cent. or more of magnesia. As stated above, this question is now being most exhaustively studied by a committee of the German Association, who have laid out a series of experiments and observations which will require five years to complete. In view of this, the writers have not attempted to investigate the injurious practical effects of magnesia.

There is another aspect of the question, however, which is of great importance to cement chemists, and that is the influence of the presence of magnesia on the proportions of lime and clay required to produce a correct mixture. If magnesia replaces lime and combines with clay, as indicated by the formulas of Le Chatelier, it must, of course, be allowed for in the calculation of the mixture. If, however, magnesia is inert, as some have maintained, it may be disregarded, and the clay used may be proportioned to the lime alone. A number of experiments were tried in the hope of throwing light on this question, and though the work is incomplete and not yet conclusive, some interesting facts were brought out which may well be briefly stated.

The first question to be studied is, whether magnesia forms with silica and alumina any compounds possessing hydraulic properties. It is well known that pure magnesia, calcined at high heat, sets with water and hardens like cement.

Pure magnesia, (German C. P.) was molded into cakes with water, dried and burned one hour at a white heat. The resulting clinker was much shrunken, brittle and hard to grind. The powder, made into a pat with water, set slowly, hard at one day, very hard but slightly cracked at the edges after several days in water. Under hot test the pat curved and cracked.

The same material, pure magnesia, burned in a crucible at bright yellow heat, showed only slight hydraulic properties, and hardened fairly. The hot test remained soft.

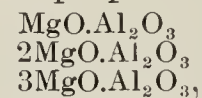
It thus appears that pure magnesia, calcined at a high temperature, possesses decided hydraulic properties, but is not constant in volume.

Magnesium Silicates and Aluminates.—Several compounds of magnesia with silica and with alumina occur in nature as minerals, and therefore would not be expected to show any hydraulic properties. Among these may be mentioned:

- Spinel, $\text{MgO} \cdot \text{Al}_2\text{O}_3$.
- Entastite, $\text{MgO} \cdot \text{SiO}_2$.
- Forsterite, $2\text{MgO} \cdot \text{SiO}_2$.

It will be remembered that the monoaluminate and disilicate of lime show decided hydraulic properties. It is therefore evident that magnesium compounds differ decidedly from those of lime in their behavior towards water.

Artificial compounds of magnesia and alumina were prepared by mixing pure magnesia and alumina in the proportions



and burning at a white heat. None of the mixtures showed any sign of fusing or sintering, and the calcined products were in all cases light, porous and soft. On pulverizing and mixing with water none of the pats showed any tendency to set, and after several days in moist air all were still soft and turned to mud when placed in water. Neither of the magnesium aluminates showed any tendency to harden in steam.

Artificial magnesium silicates were prepared from pure magnesium and silica and burned at the highest white heat of the gas furnace. The results were as follows:

$\text{MgO} \cdot \text{SiO}_2$, semifused, clinker hard, like porcelain. Powder showed no setting or hardening qualities in air, water or steam.

$2\text{MgO} \cdot \text{SiO}_2$, well sintered, clinker porous, rather hard. Powder showed no setting or hardening properties in air, water or steam.

$3\text{MgO} \cdot \text{SiO}_2$, infusible, slightly sintered, clinker porous, soft. Pat seemed to harden slowly in moist air, but after several days in air turned to mud on placing in water. No setting in steam.

From the above experiments it is evident that the compounds of magnesia with alumina and silica have no hydraulic properties, and it is quite unlikely that they play any part in the hardening of cements. Whether the tribasic silicate and aluminate exist as chemical compounds, is very doubtful.

Action of Magnesia on Clay.—At the suggestion of Dr. Aug. Dykerhoff, experiments were undertaken to determine whether magnesia has the power of decomposing clay, when calcined with it, and rendering the silica of the clay soluble. The action of lime on various forms of silica has been studied in a most interesting way by Lunge*, who found that silica of kaolin is rendered entirely soluble by calcining with lime, while precipitated and crystalline silica are less completely acted upon, the extent of the action increasing rapidly, however, with increasing fineness of division of the silica. Lunge's method consists in repeatedly digesting the product of the calcination with dilute hydrochloric acid (20 per cent.) and a 20 per cent. solution of sodium carbonate. By this treatment the lime

* Thonindustrie Zeitung, 1894, p. 655.

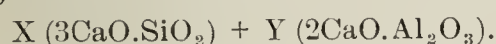
and the silica which has been rendered soluble are dissolved out, while the uncombined silica remains unattacked.

For the experiments with magnesia a clay of the following composition was taken:

Loss on Ignition.....	7.46
Silica.....	65.41
Alumina.....	16.54
Iron Oxide.....	6.06
Lime.....	2.22
Magnesia.....	1.88
	99.57

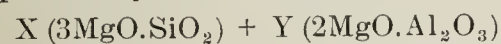
A sample of this clay was ignited at a red heat, finely pulverized, and one gram treated with hydrochloric acid and sodium carbonate according to Lunge's method. The residue was 96.24 per cent., showing a loss on digestion of only 3.76 per cent.

A mixture of clay and carbonate of lime was then prepared, corresponding with the formula



This consisted of 100 parts clay and 356 parts calcium carbonate. Burned at a high heat, a gray-green, well sintered clinker was obtained. This was ground and treated with hydrochloric acid and sodium carbonate. The residue was only 0.4 per cent., showing that practically all the silica of the clay was rendered soluble by calcination with lime.

A mixture of clay and magnesia was then prepared in the proportion required by the formula



the lime in the last experiment being replaced by an equivalent quantity of magnesia. The mixture consisted of 100 parts clay and 144 parts magnesia. Burned at a high heat, a reddish clinker, partially sintered, was obtained, which yielded a pink powder on pulverizing. This showed no hydraulic properties on mixing with water.

Allowing for the loss on ignition of the clay, the composition of this mixture, after calcination, should be

Magnesia.....	60.87
Clay.....	39.13

One gram of the calcined mixture was then treated with hydrochloric acid and sodium carbonate solution. The residue was 10.14 per cent., or about one-fourth of the clay present. Analysis of the solution and residue gave the following:

SOLUTION.

Silica.....	27.12
Iron oxide and alumina.....	15.26
Magnesia.....	48.36

RESIDUE.

Silica.....	6.63
Iron oxide and alumina.....	2.23
Magnesia.....	1.43

101.03

From the above experiment it appears that magnesia decomposes clay

when calcined with it, but that the action is far less complete than in the case of lime. The product of the calcination of magnesia and clay has, however no hydraulic properties and cannot take part in the hardening of cement.

Proportion of Clay Required with Magnesian Material.—In order to determine conclusively whether magnesia should be allowed for in calculating the proportion of clay required for use with magnesian materials, experiments were tried with a *dolomite lime* (air-slacked) of the following composition:

Lime, CaO.....	43.5
Magnesia, MgO.....	31.0
Less on Ignition.....	25.0
	99.5

By calculation it is found that to convert all the lime into cement according to the formula stated, leaving the magnesia *free*, 31.6 parts of clay (Analysis given above) will be required for 100 parts of dolomite lime.

A mixture was prepared in these proportions and burned. The clinker was dark-green and well sintered. The cement was yellowish in color, slow-setting, and hardened well in water, appearing sound at 28 days. The hot test was perfectly sound, the pat remaining on the glass.

In this cement the ratio of lime plus magnesia to silica plus alumina is 4.46, an immense excess over that called for by the formula of Le Chatelier, in which the magnesia is assumed to act like lime. It is probable, as indicated by the experiments of Dyckerhoff and others that this cement will show expansion and cracking after some time, and its behavior in this respect will be carefully watched. This defect, however, as shown by the hot test, will be due to presence of a high proportion of magnesia, and not to excess of lime or deficiency of clay.

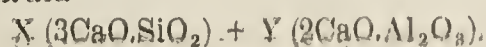
Another mixture consisting of 100 of dolomite of lime with 18 of clay gave pats which curved and cracked, both in steam and in cold water.

It thus appears that the proposed formula is applicable to magnesian materials as well as those free from magnesia, also that the magnesia should not be considered in calculating the amount of clay required.

Summary.

The conclusions to which the writers are led by the above experiments may be briefly stated as follows:

1. The essential constituents of Portland cement are tri-calcium silicate with varying proportions of di-calcium aluminate. This composition may therefore be expressed by the formula



From this formula it may be calculated that the correct proportion of lime, by weight, in Portland cement, is 2.8 times the silica plus 1.1 times the alumina.

2. Iron oxide combines with lime at a high heat, and acts like alumina in promoting the combination of silica and lime. For practical purposes, however, the presence of iron oxide in a clay need not be considered in calculating the proportion of lime required.

3. Alkalies, so far as indicated by the behavior of soda, are of no value in promoting the combination of lime and silica, and probably play no part in the formation of cement.

4. Magnesia, though possessing marked hydraulic properties when ignited alone, yields no hydraulic products when heated with silica, alumina or clay, and probably plays no part in the formation of cement. It is incapable of replacing lime in cement mixtures, the composition of which should be calculated on the basis of the lime only, without regard to the magnesia present.

THE END.

ARCHITECTURE AND BUILDING.

The New Year number of the *Canadian Architect and Builder*, Toronto, is an artistic and altogether creditable production, in keeping with the importance of the building interests. It consists of 40 pages of letterpress and 10 plates illustrative of architecture in the various parts of the Dominion. Among the more important features of this number are: A double page plate of portraits of prominent Canadian manufacturers of building materials and appliances; a double plate showing perspective view of the proposed Victoria Square opposite the new city buildings, Toronto; an illustrated article on the recent building disaster at London, Ont.; an article by Mr. G. A. Reid, R. C. A., on Mural Decoration, with reproduction of panels designed to adorn the walls of the new city buildings, Toronto; an article on the American Tall Building by Professor Capper of McGill University; a report on the recent Convention of the Ontario Association of Architects, etc.

The C. H. Little Co., Detroit, Mich., has filed articles of association with the county clerk. It will deal in stone, cement, and other building materials upon a capital of \$50,000, of which \$40,000 has been paid in.

The Knickerbocker cement works, on the river front at Newark, N. J., were damaged by fire Saturday evening, Dec. 18. The origin is unknown.

An article well advertised pays.

ARTIFICIAL STONE AND MARBLE COMPOUNDS FOR BUILDERS.

Continued from page 92, Vol. III.

ARTIFICIAL MARBLE.

No. 1.—Ingredients: 8 parts marble-dust or white limestone, 2 parts zinc oxide, 1 part Portland cement, hot aqueous solution of water-glass q. s. Mix the three solid ingredients into a paste with the solution of water-glass (which should contain about 40 per cent. of the glass), and mold the paste under pressure while warm and expose the molded form for a week or ten days to warm, dry air before finishing.

No. 2.—Ingredients: 280 parts of granite, or other stone, broken small; 140 parts of limestone or chalk, 5 parts of burned calamine, 3 parts of calcined feldspar, 2 parts of calcium phosphate, 40 parts of water-glass. Mix all the ingredients together in a dry state before adding the water-glass, then press the paste into molds and dry the finished pieces at a temperature gradually rising to 125 degrees Fahr.

No. 3.—Ingredients: Alum, water, plaster of Paris. Preparation: Dissolve alum in water (cold) until no more alum will dissolve, and then gradually stir in dry plaster of Paris until the mixture is of a suitable consistence, then spread out the plaster in slabs or form into blocks and bake it.

VARIEGATED MARBLE.

is produced artificially by mixing dry Portland cement with dry pigment that will color the cement, and the mixture is made into a paste with the least possible quantity of water. Make a separate pasty compound of each color and then place each separate compound one on top of the other and press the compound from all sides and beat it, so that the colors of the different parts impress themselves on each other without any uniformity; the result will be the production of veins penetrating the mass, which should then be sawn into plates or slabs, and these pressed in a mold for twelve days, during which time they should be kept moist as long as they are not entirely hardened. The polishing of each slab is proceeded with just like marble is polished.

IMITATION MARBLE

may also be produced from sandstone by impregnating the latter first with a solution of sulphate of alumina, and the next one of water-glass. The sandstone will thus acquire a marble-like appearance and can be polished. The sandstone when thus prepared can be submitted to a very great heat, until it is almost vitrified. It is likewise unaffected by atmospheric influences,

CONCRETES.

for floors and pavements can be prepared thus: Remove the soil to a depth of two feet, and then lay in the largest stone or rubble you can obtain to the depth of one foot, and on top of this shoot sufficient small stones—about the size of eggs—to fill up the interstices, and level the surface smooth. On top of this put a layer of coarse gravel six inches thick, and well douse the whole with water and let it remain some days until it has well settled. The stuff so laid in will form a solid body or foundation for the concrete, which should be prepared as follows: Mix one barrel of good cement with 3 pounds of clean sharp sand; well mix together in the dry state and then make the mixture into a paste by sprinkling sufficient water on it, well stirring the whole. To the compound thus mixed add two barrels of stone chips and two barrels of coarse gravel, but only as much as the paste will readily combine with. Mix all thoroughly and then tip it on the bed or foundation and level it off to its proper height. Proceed with the laying of this deposit as quickly as possible, and when the whole surface is covered, ram it down by the aid of a rammer, such as is used by paviors. Finish off the surface by laying on a thin layer of pure cement mortar to bring the surface to complete evenness. Do not let it dry too quickly, but wet it occasionally so that it shall have all the water it will absorb.

CONCRETE MARBLE.

No. 1.—Ingredients: Milk of lime (prepared by steeping lime in water, allowing it to settle, and pouring off the fluid, which is the "milk of lime" required), finely-powdered marble or limestone, or else chalk; a small quantity of coarsely-powdered limestone. Preparation: Mix the marble, limestone or chalk with the milk of lime until it acquires the consistency of paste, and to give the whole more cohesion add the coarsely-powdered

limestone. Lay the compound as quickly as possible as it dries very quickly and becomes hard.

No. 2.—5 parts coarse sand, 12 parts pebbles, 3 parts lime.

No. 3.—16 parts pebbles, 8 parts river sand, 2 parts lime. Mix with water to a suitable consistency.

SPECIAL MORTARS.

Hydraulic Mortar.—Burn some lime (CaO, calcic oxide), and then moisten the burnt lime with water and allow it to fall into a powdery condition by exposing it to the air; this powder will be calcic hydrate (C₂OH₂O—i. e., slaked lime). Separately prepare some kisselguhr (infusorial earth or fossil meal), by washing, drying, gently heating and pounding up any lumps that may be formed; then mix this fossil meal with the calcic hydrate in equal weights and mix the compound with water to form a suitable working consistence. For mortars that are not much exposed to water, mix 1 part of infusorial earth with two parts calcic hydrate (by weight). Another good hydraulic mortar may be made by mixing 1 part of alum shale with two or three parts of the slaked lime. The mixture is moistened with water for use and used as mortar. It dries very quickly, becomes hard and impermeable.

A mortar for damp places may be made by using a warm solution of green vitriol (sulphate of iron or ferrous sulphate, as it is also called), with which to slake the lime and mixing the slaked lime with very fine quartz sand.

To make ordinary mortar harden under water, add a little manganese to it.

Turkish mortar, for use in building solidly-constructed edifices, is prepared by mixing with water to the desired consistency 1 part of powdered brick and 2 parts of sifted lime. Put this on in layers of 5 in. or 6 in. thick between the course of brick and stone.—"W. C. S.," in *Building News*.

IMPORTS OF CEMENT INTO THE UNITED STATES.

WHERE FROM.	NOVEMBER.				ELEVEN MONTHS ENDING NOVEMBER.			
	1896.		1897.		1893.		1897	
	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.
United Kingdom....	19,021,147	61,591	8,810,282	28,326	243,818,515	780,339	118,741,425	367,449
Belgium.....	17,078,300	49,663	26,017,367	76,500	261,632,778	761,916	200,589,546	588,821
France.....	1,366,620	4,022	595,242	1,852	18,211,973	50,832	14,932,817	43,940
Germany.....	31,109,815	102,117	36,387,830	126,815	461,042,129	1,518,513	425,604,751	1,408,821
All Other Europe...	970,366	3,679	1,587,242	5,534	21,672,453	76,211	16,375,042	58,571
British North Am....	135,600	700	328,750	1,549	3,687,100	15,639	1,846,724	8,783
Other Countries.....					1,221,600	5,652	411	1
TOTAL.....	69,681,848	221,772	73,726,713	240,576	1,011,286,548	3,209,152	778,090,716	2,496,386
Domestic Exports of Cements, bbls.	1,873	3,812	3,985	7,114	50,163	79,484	51,168	88,816

There were 3,606,428 lbs. of imported Roman and Portland cements, etc., in the United States bonded warehouses on November 30, 1897, valued at \$10,021, against 14,355,558 lbs. value at \$42,091, in November, 1896. Imports of asphaltum or bitumen for November, 1896, were 5,550 tons valued at \$25,828; November, 1897—14,182 tons valued at \$40,421. For eleven months ending November, 1896, 61,939 tons valued at \$276,676; for eleven months ending November, 1897—121,670 tons valued at \$410,958.

CEMENT AND ENGINEERING NEWS.

(PUBLISHED MONTHLY)

WILLIAM SEAFERT, Editor and Publisher.

OFFICE—161 LA SALLE STREET.

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SUBSCRIPTION, - - - -	\$2.00 PER YEAR.
FOREIGN SUBSCRIPTION- - -	2.50 " "

ADVERTISING RATES SENT ON APPLICATION.

"This world belongs to the energetic."

Chicago, January, 1898.

CORRESPONDENCE.

We solicit correspondence on all matters of general interest to the cement trade in all of its branches. Engineering notes, public improvements, and facts and opinions drawn from practical experience will be welcome.

THE CEMENT TRADE FOR '98.

The American Portland Cement industry promises to be unusually active notwithstanding the increased capacity of the old mills, supplemented by the output of several large new works coming into the market for the first time. The demand will still be far in excess of the supply, leaving a wide margin along the Atlantic and Gulf Coast for the higher grades of European Portland cements. Large dealers heretofore drawing upon European mills are competing with one another to have their orders accepted by the American mills, and considered it as a good stroke of business policy when such orders are to be honored by the American manufacturer.

Such dealers as may have closed with American mills for a year's supply will be in position to command fair prices and ready sale for all orders so covered and there will be no necessity of cutting prices in the face of a domestic demand far in excess of the supply, at figures which are now obtained for the American Portland cement at inland distributing points.

The irresponsible contractors who rely upon low prices and usually deliver poor work should be avoided as the bane of the cement trade, either the material man, labor or consumer, suffers at their hands in each piece of work carried out and each separate

class usually suffers in turn as the opportunity offers.

They not only injure the dealer, but likewise the more honest and competing contractor by forcing down prices of good work below the real value of raw material, labor and supervision. Every dealer representing a reliable mill has a direct interest in knowing that his cement will not be abused, by his customers, in order to protect his own trade. Conservative dealers are pursuing this policy and absolutely refuse to have dealings with irresponsible contractors even when cash is advanced with the order.

The material men who will pursue this policy, using good judgment, will encounter less friction during the coming season and confer a boon upon their principles and the fair dealing contractor alike and thus cultivate the trade and good will of the best customers. Many consumers reject the tender of the lowest bidder since it carries suspicion upon its face. Sift your customers, Mr. Dealer, having these points in view, and the close of the season will show fewer losses, less friction, and better returns all round.

Tulloch & Co., cement exporters, No. 4. Fenschurch ave., London, E. C., Eng., are distributing an excellent monograph on "Cement Quality Test," which can be had on application, covering the following:

1. Influence of the temperature on setting.
2. Influence of the temperature on the tensile strength.
3. Relative influence of the different degrees of humidity of the air.
4. Influence of the different quantities of water used in proportion to the mortar.
5. Results obtained by different standard sands.
6. The results obtained by employing various kinds of sand.
7. Time required to prepare mortar, and several other valuable practical points to cement experts.

The Owen Sound Portland Cement Co. have placed an order with The Raymond Bros. for one Raymond Vacuum Separator.

MARL LAND FOR SALE.

A fine body of first-class marl land suitable for the manufacture of a high grade Portland cement. This tract contains 80 acres, showing an average depth of 12 feet. On water transportation—reaching all points on the great lakes, direct, with an abundance of suitable clay which may be dug from pits or dredged from submerged lands from three to five feet below the water surface. An abundance of cheap fuel. 12 feet of water at the docks now on premises. This marl deposit has been thoroughly tested and shows 96 per cent of carbonate of lime. An excellent opportunity for a large plant. For information address, WATER TRANSPORTATION, care CEMENT AND ENGINEERING NEWS, Chicago.

A Baltimore Lime and Cement Exchange has been incorporated. The incorporators named are Messrs. Charles H. Classen, Benjamin Wallis, Harry P. Boyd, William A. Allers, Samuel J. Diggs, Lawrence J. Warren, John S. Bullock, Harry R. Grimes, Clinton M. Johnson and Addison H. Clarke. The object of the exchange is to foster trade and commerce; to correct abuses therein; to establish and maintain uniformity in commercial usages; to settle differences that may arise; to promote harmonious feeling of mutual interest between merchants engaged in the lime and cement business; to facilitate dealings between the members of the trade by providing suitable rooms and times of meeting; to enable them to meet together and transact business, and to insure united action wherever and whenever the interests of its members are concerned.

The valuable contribution on The Constitution of Hydraulic Cements, by Spencer B. Newberry and W. B. Newberry, running through several issues of the CEMENT AND ENGINEERING NEWS has been published in pamphlet form and will be forwarded to any address on receipt of 25 cents. Write CEMENT AND ENGINEERING NEWS, Chicago, Ill.

Grover's concrete factory at Ingalls, Ind., was completely wrecked by the explosion of a 50-horse power boiler.

A Portland cement maker of 25 years' experience, good references, desires position as superintendent of works. Can take charge of erection and introduce cheap methods of production. Address, A. B. C., care of CEMENT AND ENGINEERING NEWS, Chicago.

Advertising creates a demand for the article advertised. Catch on?

Cement and Engineering News \$2 per annum.

CASTALIA PORTLAND CEMENT MILL.

Probably one of the most complete and scientifically designed and constructed cement mills ever erected in this country is now nearing completion at Castalia, Ohio, six miles west of Sandusky. The entire plant was designed and the construction superintended by Messrs. Lathbury & Spackman, engineers, of Philadelphia.

The plant is located between the C. C. C. & St. L. and L. E. & W. railroads, with siding tracks to both roads. The mill will have a capacity,

deposit of muck and extends to a depth of 6 or 7 ft., under which lays a 4-ft stratum of clay.

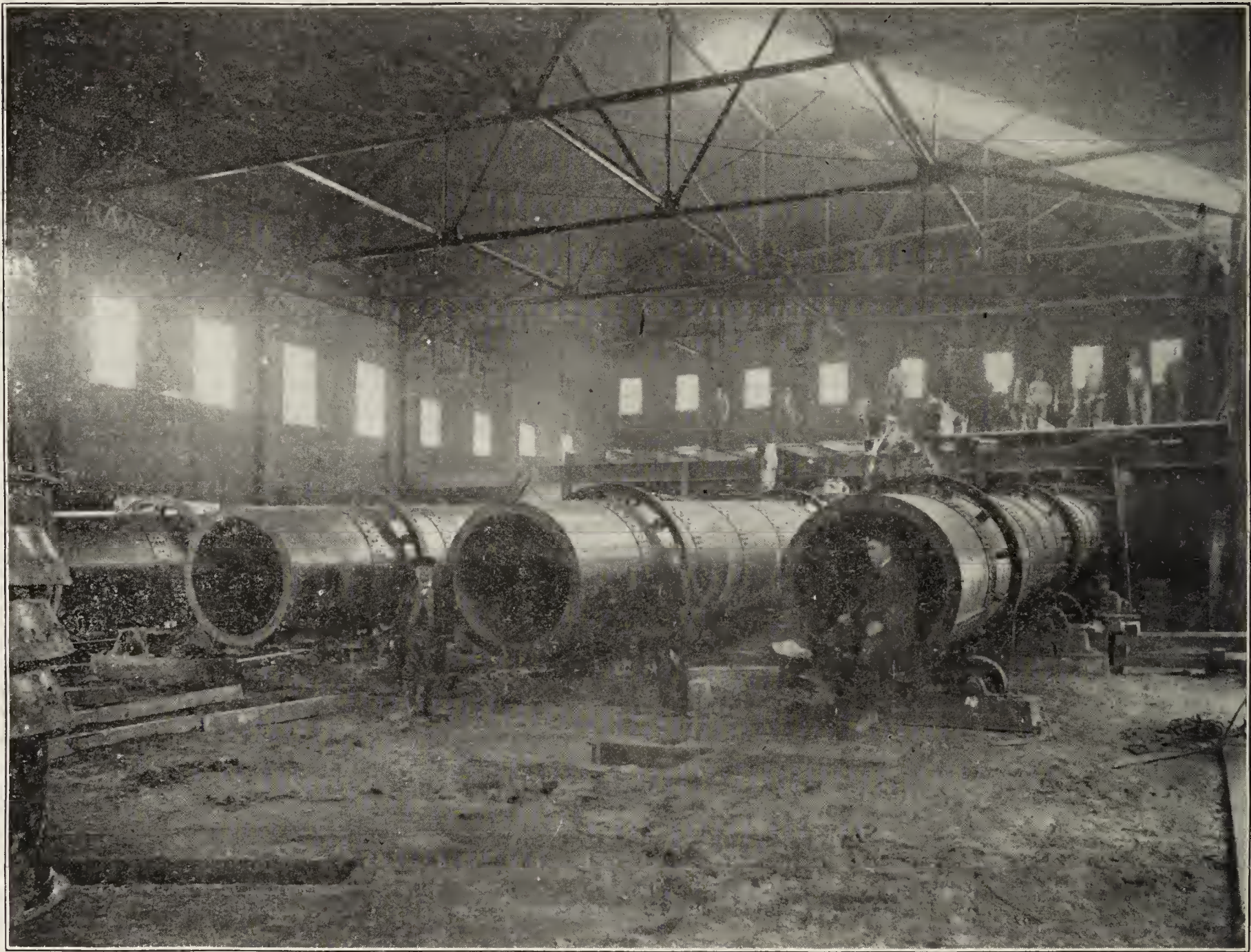
The buildings, three in number, shown on the accompanying cuts, consists of an office building 140 ft. by 150 ft. The main and engine and boiler buildings are constructed entirely of steel and corrugated iron, making the plant strictly fire proof.

The office building contains on the first floor complete and physical laboratories, general offices and private offices and bath room for the superintendent of the mill. On the second

of 150 H. P. Four boilers have already been installed.

The power plant is probably the most complete and elaborate ever designed and installed in a cement works. The water on the property containing such a high percentage of sulphate of lime necessitated the most complete apparatus for purification in connection with the condensing and piping outfit.

A feature of the power plant will be the use of mechanical stokers for the boilers and a division of the power so that each engine will oper-



Rotary Kilns now being installed at the Castalia Portland Cement Works.

The fire-brick lining remains to be placed and the hoods set. The brick work for the stacks is under way.

The men seen on the second floor are preparing to install the raw material machinery.

when started, of 600 bbls. of Portland cement per day, although the buildings are designed and a part of the machinery has been installed for a capacity of 1,000 bbls. per day.

The materials used are marl and clay, of which the Castalia Portland Cement Company own a tract of 600 acres. The quality and extent of this deposit has been carefully and systematically examined by mapping out the entire property and locating bore holes on meridian lines every 50 ft. The marl is found under a 12-in.

floor are located four sleeping rooms, together with dining room and kitchen, smoking room and bath room for the accommodation of the managing director who will live at the works. This building is frame and complete in all details and appointments.

The engine and boiler building contain two 300 H. P. compound condensing engines and one 100 H. P. simple condensing engine of the Corliss type. The boiler room will contain 900 H. P. water tube boilers, constructed in batteries of two, units

ate one of the three departments in the mill. Provision has also been made for connecting each of the compound condensing engines with any of the departments, thus insuring no stoppage of manufacture in case of a breakdown. In this building will also be located a machine shop and a blacksmith shop.

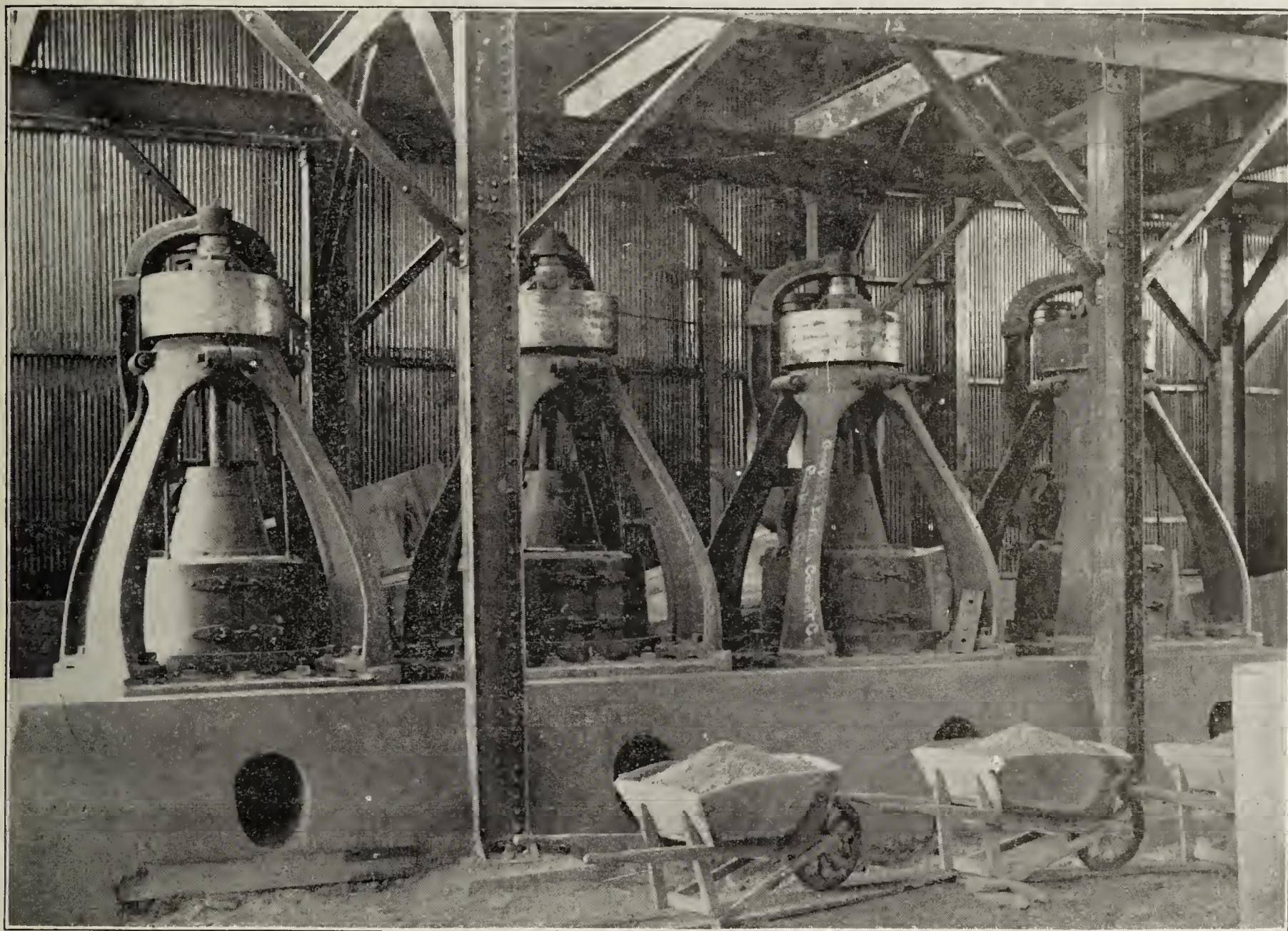
The main building containing mill and stockhouse, with a capacity for thirty days, has been constructed with the packing department at the east end with a view of extending the

stock house to the east, which will throw the packing room in the center of the stock house.

The mill is divided into three departments. First, the raw material department in which is installed all machinery necessary for the proper mixing, grinding and preparation of the marl and clay. Second, the burning department, which contains kilns and coolers for burning the carefully prepared raw material and mechanically cooling the clinker or product resulting from the calcination. Third, the grinding department which contains the machinery

tive. It is then elevated to the second floor of raw material department and passes through the various stages of mixing and grinding the two ingredients. In tanks located in this department the mixture is corrected for the proper percentage of the chemical elements. The material, after preparation, is conveyed in a liquid state to rotary kilns specially designed for burning the wet material. The resulting clinker is then elevated to special coolers, and after passing through these it is then elevated and conveyed to mills which pulverize it and grind it into Port-

duction to a minimum, care has been taken in the design and erection of this plant to reduce manual labor by the introduction of mechanical devices for handling the material wherever possible. With this end in view a most complete elevating and conveying system has been installed. A feature of the plant will be the introduction of the system of burning in rotary kilns with pulverized coal. This process, with which Messrs. Lathbury & Spackman are thoroughly familiar is a secret one used only at the Atlas and Alpha Portland Cement Works and effects a large saving in



A Portion of the Battery of Griffin Mills now being installed at the Castalia Portland Cement Works.

The holes in the foundations receive screw conveyors whereby the ground cement is removed and carried to a large conveyor which receives the product of the entire series of mills and discharges into the storage room.

for reducing the clinker to Portland cement.

The reservoir shown on the cut with a capacity of 1,000,000 gallons is used to store water for general purposes and for use in the condensers of the engines. The water is pumped from the reservoir to a storage tank located in the main building and to which is connected the piping system.

Briefly the process is as follows: The marl and clay is excavated and conveyed to the mill by railroad in small dump cars drawn by a locomotive.

land cement. The finished cement is then conveyed and distributed to the various bins located in the stock house.

After the cement has thoroughly seasoned in the bins it is then conveyed and elevated to the mixing and packing room. Here also has been introduced machinery for automatic weighing and rapid mechanical packing in either barrels or sacks. A storage house will soon be erected for finished cement which has been packed in barrels and sacks.

In order to reduce the cost of pro-

the cost of burning over oil as a fuel.

The entire plant and equipment denotes careful study of conditions by practical engineers thoroughly familiar with the manufacture of cement and represents a mill which will produce from the start the highest grade of Portland cement at the lowest cost. The conditions of the materials were first carefully studied and the machinery erected in the various departments has all been selected and designed to meet the special requirements of this plant. It is the first mill erected in this country

by contract, from complete plans and specifications and has resulted in the completion of a large plant at low cost. This work demonstrates the advisability of employing competent engineers for the erection of such a complex plant as a Portland cement mill.

THE COMMERCIAL ANALYSIS OF PORTLAND CEMENT.

The remarkable growth of the Portland cement industry within the past

quently required to furnish in short time, with reasonable accuracy, analyses of cements covering the following constituents, silica, iron and alumina (usually together), lime and magnesia. Sulphur is quite often required and carbonic acid occasionally.

Turning to his authorities, Fresenius, Cairns, Furman etc., our analyst finds many schemes for limestones, clays, feldspars etc., all excellent of their kind and covering all possible ingredients down to the alkalies and manganese, but he will find nothing

What is wanted then for practical work is a scheme covering the above mentioned components and insuring correctness within two-tenths of one per cent. The possible variation between two samples of the same cement is seldom less than two-tenths of one per cent. for any ingredient, and for practical work greater accuracy is unnecessary except, perhaps, in rare cases where magnesia or sulphuric acid approach a specified limit. It should be possible to carry through the analysis in a few hours, leaving only the magnesia to be weighed the following day, and possibly the sulphuric acid to be checked at the same time.

The writer has used such a scheme with gradual modifications for the past four years and has found it eminently reliable for all purposes where extreme accuracy is not essential to the value of the results. No originality is claimed for this scheme, the separations being, without exception, those in frequent use among analysts, the only object of this note being to show how simply and rapidly a satisfactory analysis may be performed if extreme delicacy and the determination of unimportant elements are not required.

In the first place it should be understood that Portland cement occupies a position by itself among substances to be analyzed and does not



The Castalia Portland Cement Mill looking Southeast, showing the raw material end of building and engine house. The opening in roof of main building is for kiln stacks. Office building to the left.

three or four years has had some unlooked-for effects in directions apart from the manufacture and sale of the product. In the United States especially the cement chemist has sprung up to solve the many questions regarding quality, which both producers and consumers are so ready to propound.

Specialization being the order of the day, it is but natural that from the general analyst should be evolved in time the cement expert who should devote his labors to this branch of the science alone, for there is so much to be done along this one line that the practical investigator must limit his field to narrow bounds if he wishes to thoroughly cover the ground.

As yet, however, little has been done and less published along the more practical lines. Vicat, Le Chatelier and others have gone deeply into the theoretical side of the question and have produced many interesting and valuable results. But the commercial analyst and technical cement chemist have been obliged to adapt general methods to particular uses and perhaps invent new schemes to suit their special work. This is well exemplified in the analysis of an ordinary cement whether Portland or natural rock. The chemist is to-day fre-



Castalia Portland Cement Works from the Southwest, with the stack house portion of the building, with reservoir excavation under way for water supply.

exactly suiting his requirements, for although some authors give methods for cement analysis (see Stillman's Engineering Chemistry, p. 202) they are so complex, requiring considerable time, and going into unnecessary detail, that they are almost useless to the commercial chemist to whom time is an important factor.

come under the general head of limestones, which are more or less completely dissolved in dilute acids or the clays and feldspars which, being refractory silicates and undecomposable by acids, require to be fused with alkaline carbonates before undergoing decomposition.

Portland cement will be found to

dissolve more or less readily in dilute hydrochloric acid on digestion, but that solution is incomplete is shown by the increased weight of the insoluble residue over that obtained by fusion with sodium carbonate, and the presence of small percentages of iron, alumina, lime etc. in this insoluble residue when it is subjected to fusion.

If, instead of dilute hydrochloric acid, we treat finely ground cement with more concentrated acid and to this add a few drops of nitric acid, very little besides the silica will remain undissolved on subsequent evaporation to dryness and taking up with water.

Many chemists still adhere to the longer and undoubtedly more strictly accurate method of fusing the cement with sodium carbonate and digesting

until no odor of hydrochloric acid arises from it and is then removed and allowed to cool.

A grave mistake is frequently made in not allowing sufficient time on the sand bath for complete breaking down of the soluble silicates, which does not take place until all the hydrochloric acid is gone. It is well to err on the safe side, a little extra baking will do no harm if the heat is not too high. When cool twenty c. c. of the same half strength acid used before is added and it is set again on the sand bath, boiling gently and covered closely. This is somewhat different from the books, but it is necessary to effect a complete solution of the soluble chlorides from the silica, and as the hydrochloric acid is useful later on it may as well be added now. After remaining at

water without destroying the paper. The hydroxides are then redissolved in a little hydrochloric acid and reprecipitated with ammonia, boiled, filtered, washed with hot water and then removed to a crucible, ignited and weighed.

This second precipitation of iron and alumina is quite essential since, if it is neglected, as much as three per cent of lime may be carried down with the hydroxides.

Lime.

The filtrate from the iron and alumina should measure about 300 c. c. It is well to use a No. 3 beaker holding 300 c. c. for the filtrate from the silica and to increase the size one number for each separation, ending with a No. 6 for magnesia. A few drops of ammonia should be



Engine Room of the Castalia Portland Cement Works.

The large engine in the foreground is a 300 H. P. Compound Condensing Engine.



Boiler Room of the Castalia Portland Cement Works.

in hot water, but the results of both methods on the same sample have shown that digestion with concentrated acid is quite correct enough for the generality of analyses, provided the grinding of the sample has been sufficiently fine, in fact it is the method usually adopted in the laboratories of cement factories throughout the country, in detail it is as follows:

Silica.

Having weighed out one-half gram of the finely ground and dried cement it is transformed to a four-inch evaporating dish and ten c. c. of hydrochloric acid of about half strength (sp. g. 1.20, diluted with its bulk of water) is added, together with a few drops of nitric acid, conc. The dish is covered with a watch glass on a glass triangle and placed on the sand bath where it will gently boil itself down to dryness. It should remain

least ten minutes on the sand bath fifty c.c. of water is added, the whole brought to a brisk boil and filtered, washing the silica with hot water until the acid is all gone. The filter paper (Ashless papers 11 c. m. wide are used throughout) containing the moist silica is withdrawn from the funnel, placed in a weighed platinum crucible and ignited and weighed in the customary way.

Iron and Alumina.

The filtrate from the silica is heated and ammonia added in slight excess. If this is carefully done so as to introduce only enough ammonia to render the solution slightly odorous, it need be boiled only a few minutes before filtering off the hydroxides of iron and aluminum. After rinsing the last of the precipitate from the beaker the funnel is taken from its support and the precipitate washed back into the original beaker with a jet of hot

added to it and it is then brought to boiling. At the same time 20 c. c. of a saturated solution of ammonium oxalate is heated to boiling in a small beaker and when both are in free ebullition the oxalate is added to the filtrate while the latter is briskly stirred. The whole is kept boiling a few minutes and is then set aside to cool.

If the precipitation is conducted in this manner the lime will settle at once in large crystalline flakes, enabling the operator to filter as soon as sufficiently cool—best in about 20 minutes—wash with hot water and remove filter paper with the precipitate, spreading the paper against the inside of the beaker in which the lime was thrown down. The precipitate is then washed into the beaker with a jet of hot water, finally rinsing the paper with dilute sulphuric acid.

Water to 300 c. c. and six to ten c. c. strong sulphuric acid are now added, the whole brought to incipient boiling and titrated with a standardized solution of potassium permanganate, as described by Furman in his practical assaying pp. 216-217.

Magnesia.

The magnesia is now determined by placing the beaker containing the filtrate from the calcium oxalate in cold water and, when thoroughly cooled, adding with stirring 20 c. c. of a saturated solution of ammonium phosphate. Allow the beaker to remain in the cold over night, filter, wash, ignite and weigh the magnesium pyrophosphate in the usual manner, without drying the filter paper and precipitate, but using a low heat for the ignition until the magnesia is white.

Sulphur.

For the determination of the sulphuric acid three grams of the cement are digested as above with concentrated hydrochloric acid and a little nitric acid, run down to dryness and the silica separated in the manner described, taking care, however, that the hydrochloric acid used to take up the soluble portions after roasting, is in but slight excess. Boil the filtrate from the silica and add 15 c. c. of boiling barium chloride solution (saturated) and let stand. The barium sulphate may be filtered as soon as completely settled, which will be in perhaps an hour, but the writer has always found a perceptible deposit of barium sulphate in the filtrate if kept till next day. Experiments on the same sample have proved this remainder to be not more than three per cent of the total quantity of SO_3 —or, giving the actual results in an average case, $\text{SO}_3 = 1.65\%$ and 1.70% , the first being filtered within an hour and the second the next day.

Carbonic Acid.

If it is required that the carbonic acid be determined, a very convenient method is found in Cairns' directions for the analysis of limestone. The little apparatus therein described may be used for cements provided a little water is mixed with the sample in order that it shall not cake together when the acid is drawn into the flask. It may be said, however, that at the present day the better grades of Portland cement will show so little carbonic acid, unless they happen to be very old indeed, that two or three grams will be needed for its determination, and its presence is seldom inquired after.

In the above process of analysis the writer is well aware that accuracy is somewhat sacrificed to convenience and the saving of time, and while

sharing the general prejudice against abbreviated methods, still feels that there are many cases where extreme accuracy is of no greater value than close approximation. When it is considered that two samples drawn from the same barrel of cement may, and very often do, vary as widely as one-half of one per cent, not only in the lime but in the minor components as well, it is evident that an analysis which may be relied on as correct within two-tenths of one per cent, comes well within the limits of variation between duplicate samples and is as good for practical purposes as a determination to four places of decimals.

The principal point of recommendation for this scheme is this: A sample of cement can be completely analyzed, with the exception of magnesia, in four hours, and allowing a small excess of time four to six determinations can be carried along together. The percentage of lime may be read off directly from a table as soon as titrated, and if other elements are neglected the lime alone may be reported in an hour.

The accuracy of the method for the elements existing in small quantities is shown by fifty comparative analyses made during the present year in which the same samples were analyzed by the above process in the writer's laboratory, and simultaneously by one of the leading analytical laboratories in Philadelphia. The average difference for magnesia (MgO) was $.078\%$ of the cement or 2.7% of the total magnesia present which ran about 2.85% in the cement, while the sulphuric acid (SO_3) showed an average variation between the two methods of $.071\%$ of the cement or 6.4% of the total SO_3 present which was constant at about 1.1% . This for an average of fifty samples, while far from a perfect result, shows that a fair idea of the composition of a cement may be obtained with very little labor.

WM. B. NEWBERRY.

December 17, 1897.

A new standard of specifications for street paving work has been adopted by the Chicago board of local improvements, recently. Under the new rules contractors will be required to guarantee all paving for a period of ten years, and to use nothing but Portland cement in street foundations. A six-inch concrete foundation will be required for all asphalt and brick pavement. On granite block pavement an eight-inch foundation will be required. Seventeen per cent. of cement must be used in all foundations.

Advertising is a good weapon to secure trade.

THE CEMENT LABORATORY OF THE CITY OF PHILADELPHIA.—ITS EQUIPMENT AND METHODS.

By RICH'D L. HUMPHREY; Active Member of the Club.

Read October 3, 1896.

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TENSILE STRENGTH.—DISCUSSION.

(Continued from page 88, vol. 3.)

Mr. J. F. Robeson.—There has been a good deal of very interesting talk in regard to the physical characteristics of cement. Looking at the matter from a chemical standpoint, Mr. Lewis has written a formula on the board in which the denominator is $\text{CaO} + \text{MgO}$. I can hardly think that he means that MgO could replace CaO entirely, and I should like to ask him to what extent this replacement may go, and also whether there are any specifications in use now which required any certain low percentage of lime or magnesia.

Mr. Lewis.—Magnesia is supposed to replace lime; if it does not it is very unfortunate. Magnesia has always been regarded as undesirable in cement; that is, it has been considered desirable to keep it as low as possible. The German Society has been investigating it for three years and will not report before 1898. In this country we have never given it much attention, as we did not suppose it was necessary; but we are finding more magnesia in raw materials than formerly, and every one is now giving it some attention without being able yet to say much about it. I would like to ask Mr. Humphrey whether he has included the boiling test in his specifications and whether he has developed anything new on the subject.

Mr. Humphrey.—The city does not specify definite requirements for the "hot water test" in its cement specifications. The "hot water" apparatus has been installed in the laboratory under the firm belief that good results can be obtained with it, and that it is a valuable safeguard. We are now making experiments with it and when the results assume definite shape, from which logical conclusions can be drawn, I shall endeavor to present them to the club, but in their present indefinite state I do not feel that I ought to present any half digested information.

Mr. Furber.—Referring to Mr. Leslie's remarks on the testing of cement away from the point of manufacture, differing in this respect from the testing of other building materials, such as iron, steel, brick, stone, etc., it might be said that the conditions demand such treatment in the case of cement or other similar

perishable materials. Iron, steel, etc., when tested stay "tested," but we are not willing to accept the testimony of the character of cement from the barrel head. I should like to ask Mr. Humphrey if after eliminating the sources of error which he points out, he considers the "shot" machine a reliable one for testing neat briquettes. In my experience, while I have not tested as many briquettes as Mr. Humphrey, I have found remarkable difference between tests given by the shot machine and long lever machine. The results obtained from the tests for tensile strength on a number of briquettes with the "shot" machine caused me to doubt their reliability, and as much higher results were obtained from the long lever machines I became somewhat skeptical of the results given by "shot" machines.

Mr. Humphrey.—I believe the operator should be familiar with either type of machine. The shot machine is essentially the machine used by the French and Germans, although it is much more clumsy in shape. We have both the Fairbanks and the Riehle machines in the laboratory and find that the former machine gives more uniform results. I have prepared plans for a machine which it is hoped will overcome the objections to the present types of cement testing machines and prove to be the best yet devised.

Mr. Little.—I made some tests of natural cements for the city in 1883, and could only get from 6 to 8 pounds, tensile strain, in twenty-four hours. I do not remember the results of the seven days' test. The manufacturers were consulted and agreed to furnish an "improved" cement that would stand 50 pounds in twenty-four hours. Since that time there has been a gradual increase in strength as shown by the tests.

Mr. Humphrey (Communicated). Mr. Lewis' statements, concerning the chemical relations in cement, while they may prove to be valuable checks, taken in conjunction with the physical tests cannot be followed too rigidly. The limits of the hydraulic index referred to have been differently quoted by authorities on cement and range from 40 per cent. to 70 per cent. In Spaulding's notes on "Hydraulic Cement" he states that "the hydraulic index in a Portland cement of normal composition varies from 42 per cent to 50 per cent." Le Chatelier, in his paper before the Engineers' Congress, 1893, gives two formulæ:

$$(1) \frac{Ca O}{Si O_2 - Al_2 O_3 - Fe_2 O_3} > 3.$$

$$(2) \frac{Ca O}{Si O_2 + Al_2 O_3 - Fe_2 O_3} < 3.$$

in which $Ca O$, $Mg O$ (which is added to the lime) $Si O_2$, $Al_2 O_3$ and $Fe_2 O_3$ represent the number of equivalents of these substances present. He states, that, "in a Portland cement of normal composition the proportion of lime, according to the chemical formulæ of the compound, should be greater than that determined by formula (1)" "and less than that determined by formula (2)." "It is necessary by reason of the inevitable imperfection of the mixture to keep well below this limit (formula 2), beyond which there will remain uncombined lime. Notwithstanding the care bestowed upon the burning of Portland cements, it is very seldom that they do not contain a small quantity of free lime."

Mr. Lewis in his quotation of the formula (2), and in his tabulated analyses, has not considered the percentage of iron present ($Fe_2 O_3$), which, as will be seen later, materially affects the values obtained by the formulas.

The following are two analyses of Portland cements:

No. 1.	Vicat's Formula.	Le Chatelier's Formulas.		Lewis Le Chatelier.	No. 2.	Vicat's Formula.	Le Chatelier's Formulas.		Lewis Le Chatelier.
		(1)	(2)				(1)	(2)	
$Si O_2$ 20.99	} 41.1%				21.08	} 40.7%			
$Al_2 O_3$ 4.12					5.78				
$Fe_2 O_3$ 5.18		3.9	3.1	2.8	4.89		4.5	3.2	2.9
$Ca O$ 60.75					64.27				
$Mg O$ 0.41					1.66				

Analysis No. 1 shows the cement to be low in lime, yet it is an unsatisfactory one according to Le Chatelier's formula; while according to Mr. Lewis, this cement would meet the formula, as it gives a result of 2.8.

Analysis No. 2 is high in lime and as poor an example as any quoted by Mr. Lewis. The cement of which No. 2 is an analysis has been in the work for over three years, and as yet does not show the slightest signs of unsoundness. I have also carefully observed other cements which gave equally unsatisfactory results by these formulas and have failed to find evidence of unsoundness. We study the chemical relations in the city laboratory, yet we do not deem it advisable to burden the specifications with clauses of questionable value. While deductions from these formulas may prove true of most cement analyses, nevertheless it is yet to be demonstrated that cements which fail are of bad quality, and vice versa.

Concerning Professor Porter's remarks on the value of tensile requirements in specifications, I wish to say that the requirements should be based

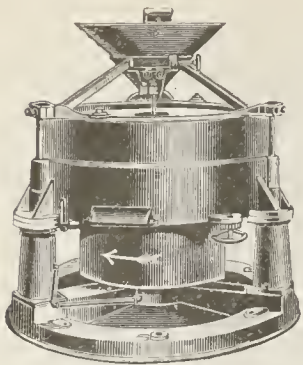
not upon the results which others have obtained, but upon the results which it is practicable to obtain under actual conditions. An engineer before preparing a specification for cement should first determine what tests he, or the person who will do the testing, can obtain from recognized high-grade cements. Upon the results of these tests he should base the requirements of his specifications. If such methods were pursued engineers would be spared the embarrassment (after finding it impossible to secure a cement which will meet the requirements) of being compelled, either to use cements regardless of the tests, or to lower the requirements, which have been arbitrarily adopted without regard to their ability to obtain the required tests.

If engineers and manufacturers would direct their efforts to securing "standard methods," they would soon realize the futility of demanding "standard specifications." Methods of testing may be systematized and made more uniform, but as long as

the results depend upon the "personal equation" of the person making the tests there can be no "universal" or "standard specification." Assuming that a "standard specification" was adopted, it would be either too low to be effective, should the tests be made by experts (because they would be able to obtain the required tests from cements of inferior quality) or it would be so high that unskilled persons would not be able to obtain the required tests from cements of the highest quality,—granting that the methods were identical in both cases. When cement can be tested mechanically, to the exclusion of all "personal equation," then we may hope to have a "standard specification" adopted.

THE END.

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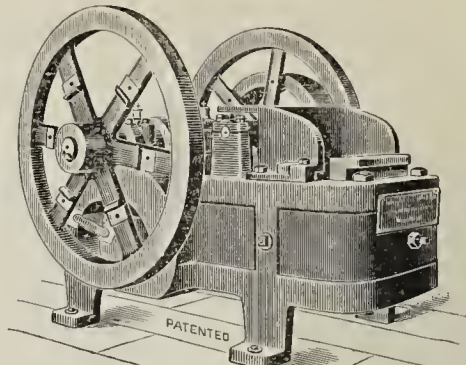
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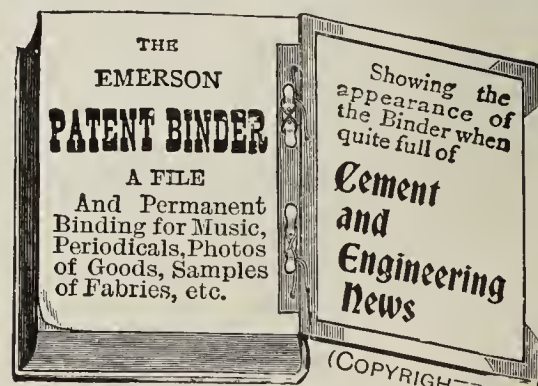
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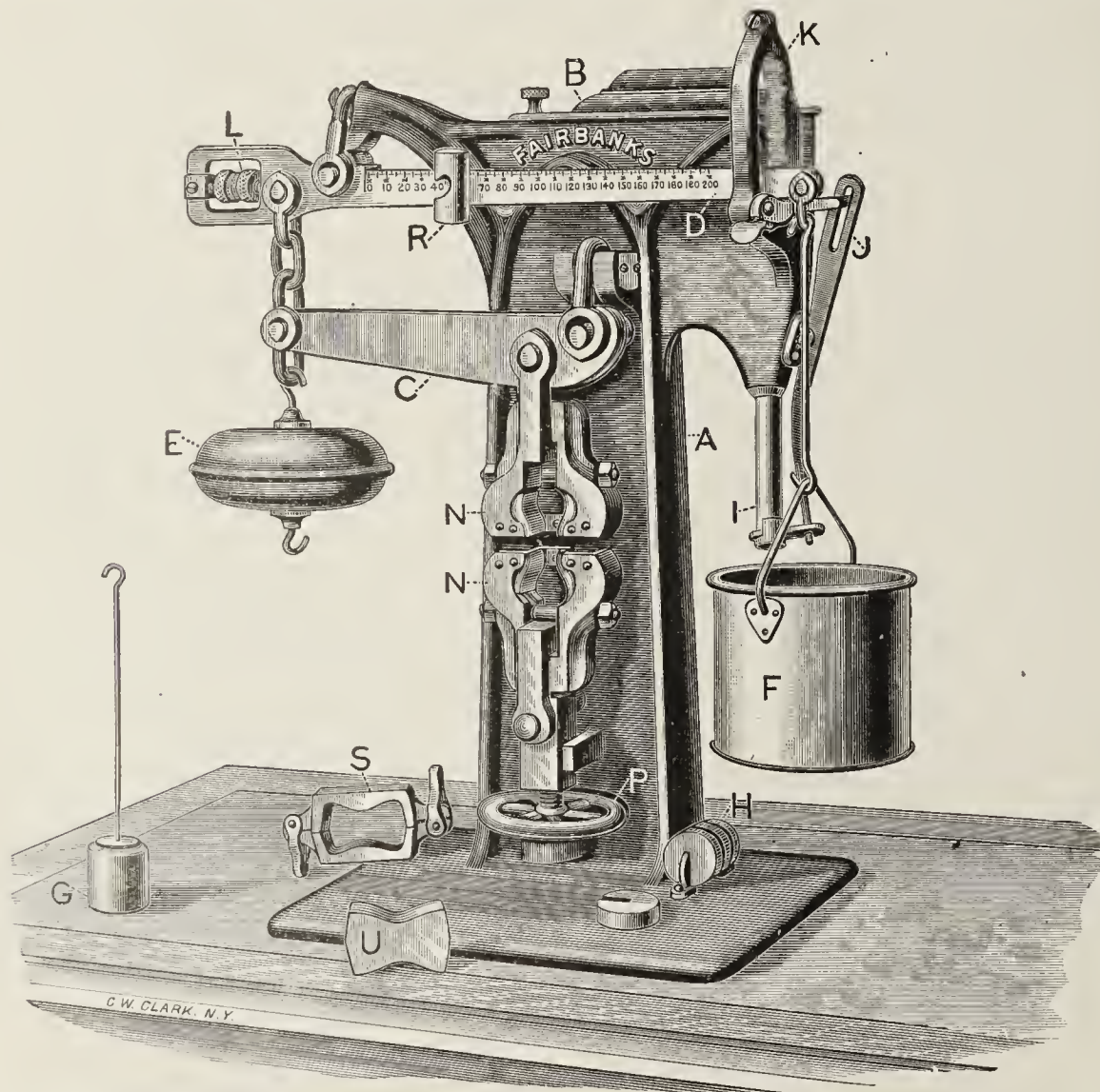


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ENGINEERING NEWS



Residence at Calumet Heights, Chicago, Constructed of Palmer's Hollow Concrete Building Blocks.

H. S. PALMER & CO.,
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FRANZ ROY,
Architect, Chicago.

The house contains ten rooms and cost \$3,500. Figures for cut stone for the same work was \$8,500. 2,700 hollow blocks were used, molded and set in the walls by six men at the rate of 200 blocks per day. A fuller description of Palmer's hollow concrete block system of construction appears on another page.

REMARKS ABOUT THE TESTING AND
GENERAL QUALITIES OF PORTLAND
CEMENT, AND SOME RULES FOR
USING IT SO AS TO GET
THE BEST RESULTS.

The following quotations are abstracted from a pamphlet entitled "Portland Cement for Engineering Works," by W. W. Maclay, C. E., which can be obtained free on application to the Commercial Wood and Cement Co., 156 Fifth Avenue, New York.

"Since Portland Cement has now established itself so firmly in the popular favor, both by the improvement and excellence shown in its manufacture and by the lowness of its cost, the price in this country having fallen more than fifty per cent. within the last fifteen years, and its strength when mixed with sand having been nearly doubled in the same time, the most important point now to be considered, next to the character of its manufacture, is the method according to which it shall be tested.

"In the testing it is the same as in the using of Portland Cement; a very little unskilfulness or inexperience will give bad results for the best quality of cement manufactured. It is clearly so much in the interest of the consumer, as well as of the manufacturer, that some standard, uniform method of testing cement should prevail, that it may be said to be a necessity, and yet in several of the largest countries where Portland Cement is used no such standard exists. Germany is entitled to the credit of having led the way in establishing a cement standard, and her example has been followed by Austria, Sweden and Russia. The working results of these systems, now over ten years old, while perhaps they have not realized all that the most sanguine have claimed, have been very satisfactory.

"In England and through her extensive colonies, in France and the United States, no official standard of testing prevails, and for this strange apathy on such an important subject probably the United States is the most excusable, and the nearest to the enjoyment of a cement standard, although it may not be an official one. In both England and France, as in Germany, the government exercises a supervision almost personal over private business and manufactures, and this would seem to make the path easy for the establishment of a uniform system of testing. In the United States, on the contrary, the supervision and regulations existing in foreign countries over private enterprises would hardly be tolerated. But while we have no official standard for testing cement here, as in Germany, a great improvement was made in the recommendation of a system, al-

though the standard was omitted, in the Report of the Committee of the American Society of Civil Engineers on a uniform system for tests of cement, made January 21st, 1885. The system for testing cement recommended by that committee has been gradually adopted by different public works throughout the country and incorporated in the cement specifications of our leading engineers, and promises to be in time the standard system for the United States. As the American system of testing becomes more firmly fixed in this country, it will probably lead to the establishment of standards of tensile strength for the seven or twenty-eight day periods in the same manner as the same manner as the system itself has been introduced. Whatever standard is adopted here, it should be less for the same period than the corresponding German standard, as the two systems of mixing the mortar are essentially different, the German method tending to give higher results."

These remarks were published about seven years ago, when most of the Portland Cement in use in the United States was of foreign manufacture and when the excellence of domestic Portland Cement was generally discredited. In these seven years we have seen a notable increase in the amount made and improvement in the quality of American Portland Cement. We have also seen the price falling, both for foreign and domestic Portland, with the quality of the domestic Portland steadily advancing by fine grinding, until now the American high grade Portland Cements easily come up to the German standard, even when tested according to the American practice of making plastic mortar, although this practice gives much lower results than testing made under the German Normal Rules.

In the American system more water is used in mixing the mortar than in the German official test, the American rule being that the mortar "should be stiff and plastic," whereas in the German test it is made like damp earth, with very little plasticity.

The American mode of testing by making the mortar plastic has the following advantages: First, mortar of a plastic consistency is more like the condition in which it is used in actual practice, and the strength deduced therefrom is more valuable as a guide to the engineer than the higher results obtained from the German method. In the second place, the plastic mortar does not admit of various degrees of consolidation in the moulds by ramming to the same extent as the stiffer mortar does, and this circumstance eliminates a good deal of the unequal personal equation

or treatment that is so much to be desired in testing cement. For the same reason, it is much preferable to have the mortar or cement paste for testing purposes mixed in a machine than to have it made by hand. This is now considered the best practice both in England and in Germany, and will doubtless soon prevail in this country. From these remarks it must not be understood that the testing of cement is other than laboratory work, for all attempts to popularize cement testing so that it can be brought within reach of all who use it have signally failed. Cement tests, to be of any comparative value, will always have to be made by persons accustomed to accurate methods and possessing a considerable degree of experience and skilfulness in this particular line of physical research, which is only to be acquired by long practice. No great equipment of scientific education is necessary for the cement tester; but on the other hand, he must have a large amount of accuracy and practical experience, with the conscientiousness that will prevent him from slighting or slurring over details in order to obtain results. In this connection it may be stated that when a standard system of cement testing was agreed upon by the engineers and manufacturers of Germany and Austria, official stations for testing cement under the standard system were established at Berlin, Munich, and other chief cities on the Continent. These stations are in charge of highly educated officials, generally chemists, and are equipped with all the most improved testing apparatus. Through the experiments and researches made at these stations the most valuable contributions to cement literature have been made. Desirable as would be the establishment of similar official government cement testing laboratories in the United States, it does not at present seem possible, for the same reasons that have been given as preventing any connection between the government and the adoption of a standard system of testing cement. In Germany strong efforts have been made to have regulations at these testing stations which should fix higher prices for cement which exceeded the requirements of the standard test, so that Portland Cement should be officially valued according to its quality. These efforts have not yet been successful, and the best manufacturers of Portland Cement are still obliged to see their cements sold for about the same price as inferior cements—a condition of affairs that would certainly seem to warrant some change.

Notwithstanding the great amount that has been written on the subject of Portland Cement testing, and not-

withstanding the vagaries and unexplained behavior of the cement itself, the fact still remains that it is perfectly possible to formulate a system of testing and chemical investigation that will in almost every case not only separate good from bad cement, but will also show the excellence of the higher grade made by the best factories in this country and abroad. As an evidence that this can be done, we have the exceedingly satisfactory working of the German Rules for testing, since 1878, although after these rules had been in operation nine years, it was found necessary to revise them, and some similar revision is now necessary in the system of tests recommended by the committee of the American Society of Civil Engineers, 1885. This system of testing has been found much fault with by certain engineers, because greatly varying results have been obtained with it in testing the same cement, by different persons, all claiming to be following the system recommended by the committee; but such faults, if they exist, can be easily remedied, in any system, by giving more details.

To the writer's mind, the great evils the Portland Cement consumers and manufacturers in this country have to contend with, are two: 1st. The absence of any recognized system of testing, such as now prevails in Europe. 2d. The very general feeling existing among our engineers, architects, and builders, that each one can decide better for himself the way to test the cement, and the standard that it should reach, than by adopting any system of testing, and standards formulated by a body of men selected for this purpose, on account of their knowledge and judgment in cement matters. The individual tester, by his own system, loses a great deal by being unable to intelligently compare his work with the experience of others, and he greatly hampers the manufacturer by his vagaries. One of these vagaries very commonly adopted throughout the country, but in use nowhere else, is the one day test for Portland Cement; this, as practical users and testers know, is absolutely unreliable to indicate the value of Portland Cement, and being very misleading should be left out of all well-drawn cement specifications.

Another misleading test for Portland Cement is the neat test, as it is perfectly possible for coarsely ground Portlands of low sand-carrying capacity to show much greater tensile strength, gauged neat, than finely ground Portlands that can be mixed with much more sand without lowering the strength of the mortar. The most unsatisfactory feature of the

neat test is its liability to decrease in tensile strength after some maximum period, usually found in dense, hard burned Portlands of the highest grade to be between three months and one year. No such decrease is shown in the sand tests, which with sound Portlands go on increasing for several years, until the maximum is reached.

In relation to supplanting the neat test by that of the cement mixed with three parts of standard sand, it is quite curious to note the reluctance with which the most prominent cement engineers give up the neat test, while acknowledging the many advantages over it possessed by the sand test.

Mr. John Grant said: "Nothing has done so much to raise the quality of cement in Germany as the adoption of the system of testing its strength when mixed with three times its weight of sand of a standard gauge and quality, and made into briquettes, which are tested when twenty-eight days old. To give a clue to any cause of discrepancy or disappointment which may arise, and for experimental purposes, it is desirable to ascertain its weight, degree of fineness, time of setting, and, where there are facilities for it, the chemical character and other features of cement. But if it give the required strength when mixed with sand after four weeks, it may be accepted without fear, and the specification is much simplified." Mr. Grant also adds, referring to himself: "The author has for several years past used the test of cement with sand, and would have adopted it long before he did but for the occasional and temporary difficulty it involves at the commencement of works carried on in public thoroughfares—of waiting a month to know the results. This can, however, in most cases be got over, either by making early arrangements for getting the cement by a tentative test at seven or fourteen days, or by other methods, approximately ascertaining the quality of that which has to be first used; but no cement should be rejected before the test at twenty-eight days has been made."

"Numerous experiments by a great number of observers in different countries have shown beyond dispute that heavy, well-burnt cements, which, when tested neat, have given high results, have, notwithstanding, when mixed with sand, turned out disproportionately weak. Even when the important test of fineness is coupled with that of weight, the strength of cement when tested neat does not always correspond with its strength when mixed with sand. The only thing wanting to make this

(sand with cement) test perfect is time—i. e., to be able to wait for the results months instead of weeks." And again: "It was agreed that the test with sand was the most important. This was proved beyond doubt by several of the tables in the Appendix ('Portland Cement: its Nature, Tests, and Uses.' Paper No. 1700, by John Grant. Excerpt Minutes of the Proceedings of the Institution of Civil Engineers, Session 1879-1880), which showed that the test of neat cement alone would lead to great errors, reduced, no doubt, but not eliminated, by coupling it with the test for fineness. *Still, the neat test had its uses, and he had always retained it, though he no longer depended upon it.*" In view of Mr. Grant's own statement as quoted above, it is difficult to see why he still retains the neat test, although "he no longer depends upon it."

Dr. Michaelis, the German authority on cement, is not much more convincing than Mr. Grant in the reasons that he gives for still using the neat test, in the same discussion from which Mr. Grant has been quoted. Dr. Michaelis says: "If the question was raised as to testing cement neat or mixed with sand, and if it were acknowledged that only one of these two methods was permissible, then there was no doubt that the decision must be in favor of the sand mixture. It was only when mixed with sand that one of the most important properties of cement could be appreciated, namely, its power of uniting other substances. This was totally distinct from its strength, and depended chiefly upon fine grinding, which was of primary importance. Fine grinding was the only rational method of utilizing the cement to its fullest capacity." And again: "The next question was whether it was right to go from one extreme to the other by giving up the test with neat cement, which had been so long customary in England, and by substituting for it the test with sand. From the commencement Dr. Michaelis had been of the opinion that the proper course lay between the two. It was the test with neat cement alone that indicated what proportion of water was the most favorable for the particular cement under examination." And again: "It was a mistake to think that the tests made with sand according to the German standard rules give more regular and uniform results than briquettes made in the same way with neat cement. A method of carrying out the latter test could quite as easily be prescribed as for the sand mixtures. He would recommend the retention of the test with neat cement."

The above quotations from those who are justly considered as among the highest authorities on cement subjects, show how much opposition there is to abandoning the neat test in favor of the sand test, and yet the change has been made in Germany, and will probably some day be universally adopted.

In a paper by David B. Butler, an eminent authority on English cement tests, he says:

"The soundness of a cement is a most important point, as it is evident that no matter to what fineness it may be ground, or what strength it may develop at the earlier dates, if it eventually expands and disintegrates, it is not only of no value as a constructive material, but it is at once converted into a destructive agent. On this point we quote the opinion of his late principal and colleague, Mr. Henry Faija, an opinion which he fully endorses, viz.: that if a cement is sound it is almost invariably strong enough for any work in which it may be used. The soundness of a cement generally used to be considered as satisfactory if a pat gauged with a minimum of water, and placed on a glass or other porous slab, showed no cracking or lifting off at the edges at the expiration of seven days, either when plunged immediately into water, placed in water as soon as set, or left in the air. The author's experience is that this test is not altogether reliable, as he has known instances in which pats treated as above were perfectly sound and good at the expiration of seven days, and the briquettes also showed good tensile strength, but when kept for a period of 28 days, both pats and briquettes have been found to show signs of disintegration. He has also known cements to give perfectly satisfactory results at the expiration of 28 days, and even then deteriorate at the end of a longer period. The most reliable test for the soundness of cements, in the author's opinion, is that which was introduced a few years ago by Mr. Faija, of which a full description is given in the paper read by him before the Society in 1885. It essentially consists in subjecting a freshly gauged pat to the moist heat of 100° F. until set, and afterwards placing it in warm water of 115° for the remainder of the 24 hours. The author has had a large experience of the apparatus for carrying out this test during the past ten years, and if a pat treated therein shows no signs of 'blowing,' the cement may be used with perfect confidence. If, on the contrary, it shows cracks or other signs of unsoundness, it is a danger signal, and the utmost caution should be used before sanctioning its use in

any constructive work.

"Of course, the indications of unsoundness may be due to the extreme freshness of the sample, in which case it is advisable to lay it out to cool for a few days before finally deciding as to its use. If at the end of that period its objectionable characteristics have disappeared, it may be assumed that it would become fit for use with a little aeration; but if on the other hand it still 'blows,' it ought not to be used on any account; or, at all events, not until sufficiently aerated to show no signs of expansion when treated as described."

It has been the practice, since beginning the manufacture of the Glens Falls Portland Cement, to subject a sample of the hourly output of the factory, as the cement comes hot from the grinding machinery, to the hot test described by Mr. Butler, only the temperature of the moist heat and of the warm water are in both cases carried up to 160° F., and in no case has it failed, so accurately proportioned and well burnt is the cement. After the cement has been seasoned in the bins, it is subjected to the Maclay hot test as described in the transactions of the American Society of Civil Engineers, October, 1892; but in no instance has any cement, passing the preliminary hot test of 160° Fahrenheit, shown the slightest symptom of "blowing," after being sent to the consumer; and none of the cement sold by this factory requires the slightest aeration, which has been recommended by many engineers as being necessary on important works, to make sure of the air slacking of the free lime, all such practice being very uncertain in its results, even where the cement requires it.

(To be continued.)

The Weston Lime and Cement Company of Kansas City, Mo., was incorporated with a capital stock of \$5,000.

ULSTER CO. HYDRAULIC CEMENT PRODUCTION FOR 1897.

Although business has been at times dull at some of the works, the total output of cement in this county for the season of 1897 has been greater than ever before, the total production being 3,463,211 barrels as shown by the following table, divided as follows:

F. O. Norton Cement Co.....	370,230
D. A. Barnhart.....	31,116
J. H. Vandemark.....	15,361
Lawrenceville Cement Co.....	480,000
N. Y. & Rosendale Cement Co...	443,760
New York Cement Co.....	260,252
Newark & Rosendale Cement Co.	175,500
Connelly & Shaffer.....	134,775
A. J. Snyder & Sons.....	170,631
Newark Lime and Cement Co...	178,644
Lawrence Cement Co.....	1,071,392
W. T. VanTassell.....	111,550
R. & C. I. Lefever.....	20,000

3,463,211

The total output for each year, from 1887 to date, shows a steady increase each year, with the exception of 1893, as will be seen by the following table:

1896.....	3,426,692
1895.....	3,230,051
1894.....	2,659,604
1893.....	2,738,887
1892.....	2,833,101
1891.....	2,815,010
1890.....	2,683,579
1889.....	2,547,225
1888.....	2,262,984
1887.....	2,338,744

It will be noticed that one company, the Lawrence Cement Co., produced almost one-third of the total output for '97.

The Berkshire Cement Co., whose plant is now situated at the foot of Ninth street, East River, New York city, has leased from Frank Beck at Stamford, Conn., and south of the Lincrusta factory consisting of a strip about 300 ft. long, having a water frontage for the entire length. The company will very shortly erect upon this site a two-story factory building 250 ft. long for the manufacture of a white cement.

IMPORTS OF CEMENT INTO THE UNITED STATES.

WHERE FROM.	DECEMBER.				TWELVE MONTHS ENDING DECEMBER.			
	1896.		1897.		1896.		1897.	
	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.
United Kingdom....	10,990,702	35,941	18,996,014	63,807	252,535,603	808,550	137,737,439	451,256
Belgium.....	13,258,908	38,369	18,472,020	60,854	280,394,003	813,887	219,061,566	649,675
France.....	354,500	1,086	156,300	634	13,062,720	38,317	15,089,117	44,574
Germany.....	30,270,774	104,809	18,107,091	59,024	493,332,503	1,629,785	443,711,842	1,467,845
All Other Europe...	1,218,234	4,769	2,391,271	6,889	22,890,887	80,963	18,766,313	65,460
British North Am...	70,000	300	116,250	528	4,012,350	17,272	1,962,974	9,311
Other Countries.....	.....	.....	.....	.....	1,221,600	5,652	411	1
TOTAL.....	56,163,118	185,274	58,238,946	191,736	1,067,449,666	3,394,426	836,329,662	2,688,122
Domestic Exports of Cements, bbls.	4,676	7,263	2,298	4,868	54,839	86,757	53,466	93,684

There were 4,096,609 lbs. of imported Roman and Portland cements, etc., in the United States bonded warehouses on December 31, 1897, valued at \$11,767, against 11,667,479 lbs., valued at \$33,141, in December, 1896. Imports of asphaltum or bitumen for December, 1896, were 3,294 tons valued at \$9,423; December, 1897—5,455 tons valued at \$16,432. For twelve months ending December, 1896, 95,233 tons valued at \$286,099; for twelve months ending December, 1897—127,325 tons valued at \$427,390.

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ADVERTISING RATES SENT ON APPLICATION.

"This world belongs to the energetic."**Chicago, February, 1898.****CORRESPONDENCE.**

We solicit correspondence on all matters of general interest to the cement trade in all of its branches, Engineering notes, public improvements, and facts and opinions drawn from practical experience will be welcome.

AMERICAN PORTLAND CEMENT INDUSTRY.

The manufacture of Portland cement in the United States has assumed great proportions and from the present outlook presents flattering invitations for capital to engage in its production. Capital has responded and in many sections of the country new mills are projected and in process of erection, when these new mills come into operation, with those already in being, the combined output must exceed the commercial demand even measured by the extraordinary growth in our domestic consumption during the past two years.

The result must be a decline in price and consequently a shrinkage in earning capacity of capital so far invested. With reduced dividends greater regard must be given to economy in its production. Those plants equipped with high class modern machinery and who have passed the experimental stages incident to new or unfamiliar material, and untried machinery, and at the same time are favorably located to commercial distributing centers, having reasonable carriage charges will be least affected by a moderate decline in prices.

The numerous small plants now under consideration who desire to enter the field as producers by the

aid of cheap machinery and lacking in experience will be the first to suffer. Cheap machinery is poor investment as the product it delivers will scarcely meet the requirement of engineers and the general consumer who have been educated to demand under guarantees the highest grade of cement only. Strictly modern machinery modeled after that installed in the Lehigh mills has given good commercial results, therefore new mills coming into being on the same lines will have the advantage of starting right whether the plant be large or small. At the present time there are too many original ideas floating in the brains of inexperienced cement plant projectors which must pass through costly experimental stages to attain perfection. These experiments are costly, and invade and often consume the capital invested in the project without obtaining the end in view. The present outlook will not always be a criterion for the future and the danger of overproduction should be well and fairly considered.

CONCRETE SEWER IN CHICAGO.

The subject of concrete sewers has been under investigation by the city authorities of Chicago and has found strong advocates inside and outside the city hall, and was on the point of being adopted for the intercepting sewerage system strictly upon the merits of concrete as a suitable material, when the influence of the Chicago Brick Trust suddenly intervened assisted by the Bricklayers' Union. The matter was made a political issue. Up to the evening of the meeting of the common council the concrete had a majority in its favor. On a vote of that body on the subject the concrete sewer proposition was lost by a single vote decoyed into the camp of the brick trust at the last moment.

The interest of the Brick Trust will be noted and consists in raising

the price of brick from \$4.00 to \$5.75 per thousand. The extra \$1.75 will be laid upon the tax payers as tribute to the trust. In 1897 the concrete sewer system was under consideration by the city authorities, not showing the strength developed this year.

A concrete sewer system is bound to come for Chicago in the near future. The concrete men feel encouraged.

CEMENT MILL DESTROYED.

The large plant of the Bonneville Cement Company, near Siegfried's Bridge, was destroyed by fire Jan. 27 entailing a loss of about \$100,000 on which there is an insurance of \$40,000. The flames were started by the explosion of a can of kerosene oil in the boiler-room, about 4 o'clock A. M., and in a few minutes the entire structure was on fire. The company had a pump and lines of hose, but the fire soon had the belts burned from the engine and the pumping was stopped. After that there was practically no obstruction to the progress of the flames. The building was about 300 ft. long, 60 ft. in width and two and three stories high in different sections.

Of the 150 men employed at the works fifty were on duty at the time, but could do nothing more than save the cooper shop and supply house that stood a short distance from the main building. The plant had a large capacity. The flames were about two hours destroying the structure. The works will be rebuilt and in operation during the coming season.

CASTALIA PORTLAND CEMENT.

In describing this plant in our last issue the original manuscript as received did not contain the size of the buildings, one line having been dropped in the fourth paragraph. The corrected reading is as follows:

"The buildings, three in number, shown in the accompanying cuts, consist of an office building 50 ft. by 30, main building 360 ft. by 75 ft. and engine and boiler building 140 by 50 ft."—ED.

The valuable contribution on The Constitution of Hydraulic Cements, by Spencer B. Newberry and W. B. Newberry, running through several issues of the CEMENT AND ENGINEERING NEWS has been published in pamphlet form and will be forwarded to any address on receipt of 25 cents. Write CEMENT AND ENGINEERING NEWS, Chicago, Ill.

THE ADULTERATION OF PORTLAND CEMENT.

Abstract of paper by Stanger and Blount, read before the London Section of the Society of Chemical Industry, Nov. 1, 1897.

Condensed for the Cement and Engineering News.

During the last few years two notable tendencies have been apparent in the manufacture of Portland cement. One is the tendency of manufacturers to study the principles of manufacture more closely, and consequently to turn out a product of ever improving quality. The second is the tendency of certain other manufacturers to adulterate their product with cheap foreign substances, and to sell the mixture as Portland cement. Some makers who practice the addition of foreign substances to Portland cement do so openly, and with the avowed belief that the cement is improved thereby. Others adulterate grossly and secretly until detected and ignominiously exposed.

In November, 1894, the writers were requested by the London Chamber of Commerce to investigate the effect on Portland cement of the admixture of various foreign substances, especially of Kentish rag-stone. The results of our labors, which occupied more than a year, were embodied in a series of reports to the Cement Trade Section of the London Chamber of Commerce. Together with other evidence collected by that body, they formed the basis of a report by that Section, and of a resolution to the following effect:

"That Portland cement be defined as a mixture of two or more suitable materials, intimately and artificially mixed in the requisite proportions, and afterwards properly calcined and ground, to which nothing has been added during or after calcination, excepting that an addition not exceeding 2 per cent. of gypsum is permissible for the purpose of regulating the setting."

With the express permission of the London Chamber of Commerce, the writers are now in position to lay before the Society of Chemical Industry some of the chief facts and deductions which have been the fruit of their investigation.

On the question arising as to the effect of an addition of rag-stone to Portland cement, it would appear obvious, on chemical grounds, that rag-stone would be an inert substance, and could be regarded merely as a diluent. Kentish rag-stone is a natural form of carbonate of lime mixed with silicious matter. When the stone is powdered and mixed with water, it is in no way cementitious, and shows no tendency to set. Nevertheless it was stated, by those that had made the experiment, that this

inert, silicious limestone could be added to Portland cement in considerable quantity (10 to 20 per cent.) with positive advantage to the cement, and that the cement thus diluted was actually stronger than in its natural unmixed state.

In all cases the writers' experiments were made on cement and rag-stone ground together as in actual manufacture. Mixtures containing 10, 20 and 50 per cent. of rag-stone were prepared in this manner, and tested at 7 and 28 days and at 6 months, neat and with sand, in tension and compression, and compared with corresponding tests made on unmixed cement. The results show beyond doubt that some cements are actually stronger, both neat and with sand, when mixed with 10 to 20 per cent. of rag-stone.

After some study the reasons for this apparent anomaly were discovered. The rag-stone contains a small quantity of moisture, which slakes any over-limed portions which may be present. A moist rag-stone performs the function of limited hydration, and thus subjects the cement to artificial and rapid aeration. Cements which are not perfectly sound are improved by this procedure. But when a cement has already been rendered perfectly sound by aeration, this improvement disappears. In an aerated, and therefore perfectly sound, cement, the rag-stone acts precisely as would be expected, viz., as a mere diluent.

A word must be said as to what is meant by the term "soundness." A cement may appear perfectly sound to ordinary tests, and yet after setting may develop internal stresses, which, though not sufficient to cause it to disintegrate or show any sign of actual failure, may diminish its strength appreciably.

TENSILE TESTS, SERIES A.

Breaking strain in pounds per square inch.

	NEAT TESTS.		
	7 days.	28 days.	6 months.
Unmixed cement.....	513	678	722
10 % admixture.....	665	635	795
20 % ".....	522	637	702
50 % ".....	327	503	583

	SAND TESTS.		
	7 days.	28 days.	6 months.
Unmixed cement.....	192	270	327
10 % admixture.....	172	273	342
20 % ".....	132	222	302
50 % ".....	110	143	255

TENSILE TESTS AFTER AERATION, SERIES A.

	SAND TESTS, SERIES A.	
	7 days.	28 days.
Unmixed cement.....	257	303
10 % admixture.....	210	303
20 % ".....	173	250
50 % ".....	95	140

	SAND TESTS, SERIES B.	
	7 days.	28 days.
Unmixed cement.....	293	383
10 % admixture.....	287	357
20 % ".....	243	310
50 % ".....	200	263

Reverting to the question of the difference in strength of unmixed cement and cement mixed with rag-stone, it will be observed that though sound cement is not improved by the

addition, but is, on the contrary, deteriorated, yet the decrease of strength is smaller than that which corresponds with the percentage of diluent added. The reason for this becomes clear on studying the structure of set cement. Thin sections of the different mixtures with rag-stone, examined under the microscope, show great differences. The section of a briquette made with 10 per cent. rag-stone shows a closer structure than any of the others, very few gaps appearing in it.

Actual measurement of the total amount of voids in the set cement and in the mixtures shows that a maximum density occurs with the 10 per cent. mixture.

PER CENT. OF VOIDS.

	Series 1. per cent.	Series 2. per cent.
Unmixed cement.....	4.63	2.39
10 per cent. mixture.....	3.83	1.80
20 " " ".....	6.32	3.79
50 " " ".....	10.43	6.32

It will be seen that the large quantity of rag-stone in the 50 per cent. mixture communicates to it a loose and porous structure, yet the 10 per cent. mixture preceptibly exceeds the unmixed cement in closeness of texture, this fact serving to confirm the microscopic observations.

From both microscopic examination of the structure, and from measurement of the cavities in briquettes of unmixed cement and of cement mixed with 10, 20 and 50 per cent. of rag-stone, it is evident that a mixture containing 10 per cent. of rag-stone has a closer structure than any of the others, even than unmixed cement. The rag-stone in fact, during grinding, yields a quantity of fine powder which serves as a "filling" between the crystals formed when the cement sets. The absence of interstices thus caused appears to compensate in some measure for the fact that the rag-stone is inert, and thus a cement containing 10 per cent. of what is simply a diluent is not necessarily 10 per cent. lower in strength than an unmixed cement. In fact, a briquette, even of neat cement, may be regarded as a concrete in which the strength depends not only on the true adhesive and cohesive quality of the cement, but also the exact fit of the particles of cement and those of the inert matter, such as the coarse core. Any fine inert filling material may improve the closeness of texture of such a concrete if the average size of its particles be such as to occupy fully the spaces naturally present in set cement.

The whole question concerning the addition of rag-stone may be summed up very briefly:

1. Rag-stone is not a cementitious substance, and its addition to cement is an adulteration.
2. Perfectly sound cement is

weakened by the addition of rag-stone.

3. This weakening is not fully proportional to the percentage of rag-stone added, because the latter acts as a fine filling material and fills up the interstices naturally present in set cement.

4. Cement which is not perfectly sound may be temporarily improved by the addition of ragstone. When the cement has become sound by aeration, this improvement disappears.

Many minor points were examined and determined in the course of the main investigation, but the most important results are embodied in the conclusions given above.

ADDITIONS TO CEMENT OTHER THAN RAGSTONE.

Gypsum is largely used, in quantities not exceeding two per cent. in order to lengthen the setting time of the cement. In quantities smaller than two per cent. it does not affect the cement injuriously, so far as our own experiments indicate. The average results obtained with cement containing 0.1 to 2.0 per cent. of gypsum are given in the table below.

Breaking weight of Briquettes, per square inch, 28 days.

	Sample 1.	Sample 2.
Unmixed cement	618	800
0.1 per cent gypsum	587	693
0.3 " " "	630	750
0.5 " " "	623	777
0.7 " " "	590	813
1.0 " " "	690	823
1.5 " " "	657	890
2.0 " " "	613	860

The effect of gypsum on the constancy of volume of the cement was also determined by measurement of test bars in a Bauschinger apparatus. A slightly greater tendency to expansion was perceptible when the proportion of gypsum exceeded one per cent., but the difference is not so great as to warrant the conclusion that gypsum causes any dangerous amount of expansion. The rule adopted by the London Chamber of Commerce expressly excepts gypsum in quantities up to 2 per cent. from the category of substances which, if added to Portland cement, constitute adulteration. A similar convention has been in use for some years in Germany, and appears to have worked satisfactorily.

The last and worst adulterant with which it is our purpose to deal is blast-furnace slag. This most objectionable addition is not employed on the Thames and Medway, but in certain other districts it is used in large quantities for the preparation of a grossly sophisticated product which is fraudulently sold as Portland cement.

We must not be understood as condemning true slag cement, made by

mixing granulated blast-furnace slag with slacked lime, and sold under its proper title. This material is a perfectly legitimate product and has its own uses. But the addition of slag to Portland cement is another matter. The general practice of the manufacturers who seek to increase their profits by the use of slag appears to be to add to the clinker as much crude slag as can be mixed without risk of detection. The quantity added may be as great as 30 or 40 per cent. A cement thus dosed with granulated slag could not legitimately be termed Portland cement, and would have to be sold under a distinctive name. It may be mentioned that ordinary slag contains a good deal of sulphur in the form of calcium sulphide. This, slowly oxidizing, would be likely to expand in the mass of the set cement and cause stresses, which could hardly fail to be injurious, and might be positively dangerous.

When the slag added to Portland cement is not granulated blast-furnace slag of the best composition for acting as a pozzuolana, but is the common stony material run out into trucks and allowed to cool, the objection to its addition is even stronger. This stony, slowly cooled slag is usually not of such a composition as to allow it to act as a pozzuolana. Its tendency to unite with the lime liberated in the setting of Portland Cement would be likely to be small. It may be regarded as a diluent and a make-weight. Much of this slag contains a notable proportion of sulphur and the objectionable effect of the slow oxidation of this sulphur holds equally in this case.

It is evident that the addition to Portland cement of blast-furnace slag as usually practised is not only an adulteration, but is also an adulteration with a dangerous ingredient. Fortunately, this form of fraud is readily detected by analysis, although often escaping recognition by the usual mechanical tests.

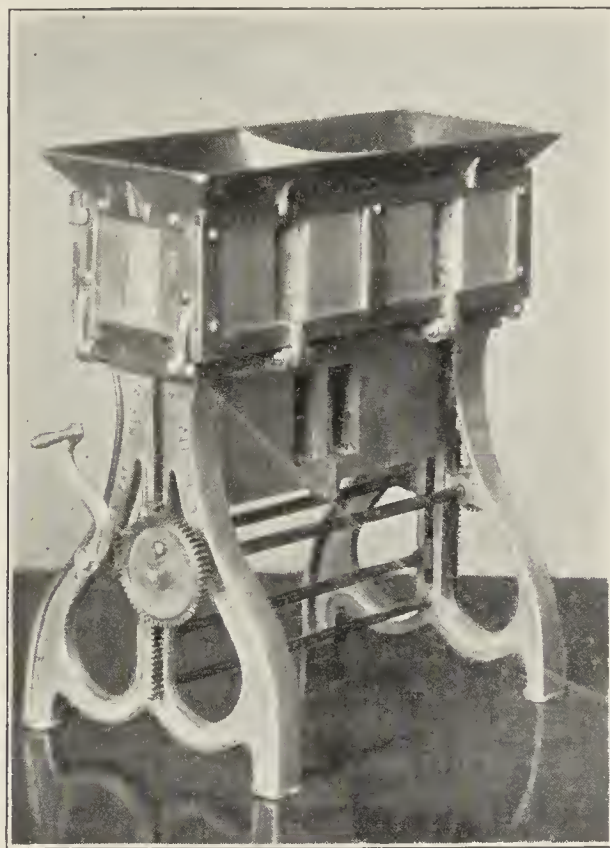
In conclusion we may reiterate our views as clearly and briefly as possible.

All materials added to Portland cement after the clinker comes from the kilns are adulterants, with the exception of gypsum, which is a recognized addition for a specific purpose, in quantities not exceeding 2 per cent. Of the two adulterants which have been specially dealt with, viz., ragstone and blast-furnace slag, the latter is by far the more objectionable, and it should be condemned and rejected by makers and users alike. In this view we believe we are supported by the great majority of engineers and manufacturers.

PALMERS HOLLOW CONCRETE BUILDING BLOCKS.

Concrete construction is coming into more general use in domestic architecture in the United States. It has been retarded in the past from lack of knowledge of the possibilities to which concrete so readily lends itself in the hands of ordinary workmen after a short experience and simple machinery now in the market.

We illustrate, on another page, one of numerous dwellings constructed with Palmers hollow concrete building blocks, formed by a simple machine, herewith for the first time shown. It has a capacity of from 80 to 200 blocks per day, depending on the number of men operating it. The process of manufacture and system of building construction was given in a former issue, which we reproduce as follows:



Hollow Concrete Building Block Machine.

The manufacture of these concrete blocks is extremely simple and practicable, the operation being substantially as follows: Two men with a horse and wagon drive to the ground with the molding machine where the building is to be erected. The cement and sand being on the ground the machine is set up and the mixing of the concrete begins. Within the first half hour the blocks begin to leave the machine at the rate of 80 blocks per day for two men. One man does the mixing and the other fills and tamps the concrete in the mold. When the tamping is completed the block is at once removed and carried away to dry, the next minute the same mold is again filled and the operation repeated continuously, the same mold being emptied and filled each time.

Five men can produce 200 finished

blocks per day on a single machine, thus giving an output of 500 lineal ft. 8 ins. high per day. One of these blocks set in the wall equals 40 brick. The inside of the wall calls for only a single coat of plaster to give it the proper finish. In making the block hollow fully 40 per cent. of material is saved; this brings the first cost below a brick wall of the same dimensions, at the same time giving good facilities for distributing gas and water pipe to any point in the building, the same being true of electric wire or speaking tube service. The material being fire proof reduces the cost of insurance. The inside of the wall finish is sufficiently smooth to receive wall paper without the plaster finish where a greater economy in first cost is desirable. The outside finish of the block may be varied by inserting a removable leaf in the mold which forms the pattern desired. This enables the contractor to work after special designs of the architect, this is first produced in wood and then cast in iron at a small cost.

Door and window frames are firmly held in position with lugs setting back in the recess which is molded into the end of every block. Window sills are also grooved and fit firmly onto the tongues of the wall, which is always level, plumb and true, provided sufficient care was taken with the first course. One foreman and two laborers can lay 400 sq. ft. of wall in one day that cannot be surpassed by any wall of brick or stone.

These houses are always dry, ventilated and cool in summer, warm in winter, durable as well as artistic and a success in every way.

The building department of the city of Chicago, acting under stringent rules and regulations, have given its unqualified approval to the Palmer system of construction.

In making the blocks it is only necessary to have good sand and good cement. Artificial stonemakers are numerous, but others who wish to learn can do so with little time and expense, and a profitable business can be carried on with a small capital.

Parties connected with the Bonneville Cement Co. of Siegfried, Pa., control three Eastern states. M. O. Luttgen, of Minneapolis, Minn., operate three Northwestern states and Peter Otto, the city and county of New York under license from the patentee.

The entire machinery for producing these blocks can be had for \$250, with an extra compensation for the right to work under the patent depending on the location and extent of territory to be operated, and offer an

inviting field wherever building operations are carried on and especially to workers in concrete, as it extends the range of their calling with handsome profits. Full particulars may be obtained from the patentee, H. L. Palmer & Co., 8904 Houston ave., South Chicago, Ill.

CORRECTION IN LE CHATELIER FORMULAS.

CITY HALL, PHILADELPHIA,
Feb. 23d, 1898.

WILLIAM SEAFERT, Editor
Cement and Engineering News.
DEAR SIR:

In closing the discussion of the paper on the "Cement Laboratory of the city of Philadelphia, its Equipment and Methods," the writer quoted Le Chatelier's formulas as they were printed in the transactions of the American Society of Mining Engineers, which contain the paper presented by Professor Le Chatelier at the Congress of Engineers at Chicago in 1893.

The second formula is incorrect as it is printed. In reply to a letter of inquiry, Mr. R. W. Raymond, secretary of the American Society of Mining Engineers, made the following statement:

"The two formulas to which you (the writer) refer came to me in Prof. Le Chatelier's original copy as follows:

$$(1) \frac{\text{CaO}}{\text{SiO}_2 - \text{AC}^2\text{O}_3 - \text{F}^2\text{O}_3} > 3$$

$$(2) \frac{\text{CaO}}{\text{SiO}_2 + \text{AC}^2\text{O}_3 - \text{F}^2\text{O}_3} < 3$$

"I have kept the original, and I copy the above from it. It was typewritten, and not free from typewriters errors, most of which the author had corrected with a pen, showing that he had revised the whole.

"The formulas were not typewritten; nor did they seem to have been written by him.

"They were put in with a pen, in a laboriously careful style, practically printed. I concluded that they had been very faithfully copied in by a clerk, who had made mistakes only where the Professor's manuscript was illegible. Thus AC^2O_3 I thought was clearly a clerk's misunderstanding of Al^2O_3 ; and F^2O_3 I took for a similar misunderstanding for Fe_2O_3 . The expressions as they stood had no meaning and the context seemed to prove clearly that this was the right correction. The + and -- signs were put in special clearness and care and were repeated on a following page, when the formulas were used again. I assumed that they were correctly reproduced. Finally I sent the translation to the author, who approved it before publication."

This letter did not appear to settle the question satisfactorily so the writer wrote to Professor Le Chatelier, calling his attention to this matter and asking him if the formulas were correctly printed, and received the following in reply:

"The formulas that I have given to define the comparative limits of Portland cement, are the following:

$$\frac{\text{CaO} + \text{MgO}}{\text{SiO}_2 - \text{Al}^2\text{O}_3 - \text{Fe}^2\text{O}_3} \geq 3$$

$$\frac{\text{CaO} + \text{MgO}}{\text{SiO}_2 + \text{Al}^2\text{O}_3 + \text{Fe}^2\text{O}_3} \leq 3$$

"But latterly having recognized that the tri-calcic ferrites slag like lime, I have modified the second formula in the following manner:

$$\frac{\text{CaO} + \text{MgO}}{\text{SiO}_2 + \text{Al}^2\text{O}_3} \leq 3$$

but I have never given the formula

$$\frac{\text{CaO} + \text{MgO}}{\text{SiO}_2 + \text{Al}^2\text{O}_3 - \text{Fe}^2\text{O}_3} \leq 3$$

"If it is found in my memoir of the Congress of Chicago, it is an error that I have permitted to escape me in correcting the English translation."

Accompanying this letter was a copy of his original paper (in French) in which the formulas appear as he states them in his letter.

The writer feels, therefore, that it is his duty to correct the errors which appear in formula (2) and the table accompanying his discussion, viz.: $-\text{Fe}_2\text{O}_3$ should read $+\text{Fe}_2\text{O}_3$, and in columns (2) of the table, 3.1 should read 2.6, and 3.2 should read 2.7.

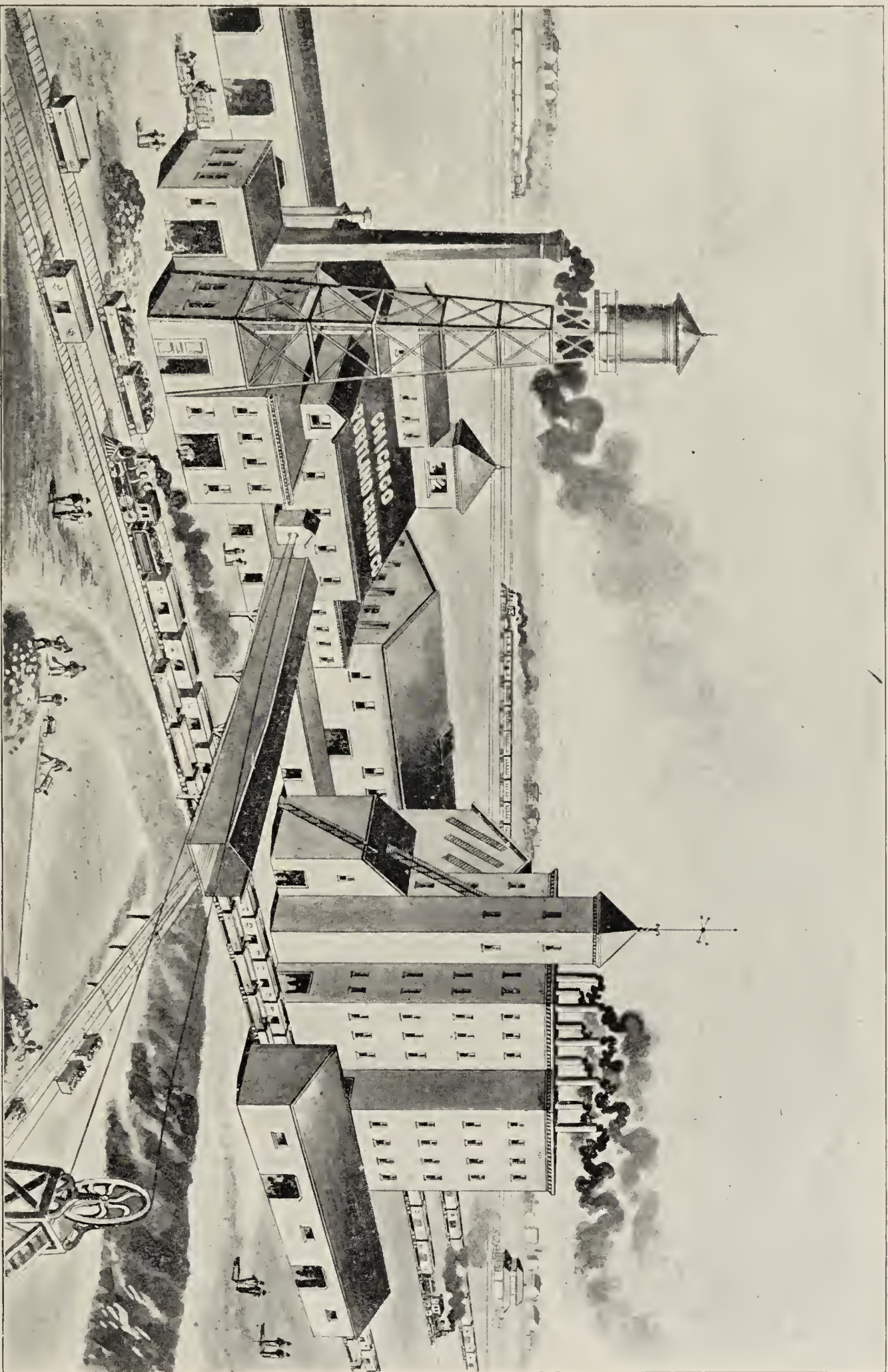
Yours truly

RICHARD. L. HUMPHREY,
In Charge of Testing Laboratory.

MARL LAND FOR SALE.

A fine body of first-class marl land suitable for the manufacture of a high grade Portland cement. This tract contains 80 acres, showing an average depth of 12 feet. On water transportation—reaching all points on the great lakes direct, with an abundance of suitable clay which may be dug from pits or dredged from submerged lands from three to five feet below the water surface. An abundance of cheap fuel. 12 feet of water at the docks now on premises. This marl deposit has been thoroughly tested and shows 96 per cent of carbonate of lime. An excellent opportunity for a large plant. For information address, WATER TRANSPORTATION, care CEMENT AND ENGINEERING NEWS, Chicago.

Marquette Cement Company, Chicago; capital stock \$250,000; incorporators, William W. Gurley, Will H. Clark and Howard M. Carter.



Chicago Portland Cement Company's Works recently destroyed by Fire.

The extensive plant of the Chicago Portland Cement Company, located at Hawthorne, a suburb of Chicago, has been undergoing repairs and enlargement during the past three months to bring the capacity of the plant up to 400 bbls. a day and expected to go into operation by the first day of March. The plant was completely destroyed by fire the morning of February 13th. The village fire service was inadequate to cope with the conflagration, the nearest fire plug being 3160 ft. from the works. The fire service of Morton Park and Clyde, two miles distant were summoned, and by their assistance a stream of water was turned upon the flames, which in the meantime gained such headway that all attempts to quench them were futile. These works covered about two acres of ground and consisted of six large buildings, mostly of wood. The loss was \$100,000, insurance \$39,500. The works will be rebuilt, after carefully drawn plans, with a capacity of not less than 500 bbls., with provision for enlargement to 1,000 bbls. per day. The company manufactured "AA" Portland Cement, which had acquired a high reputation and was much sought after in the markets tributary to Chicago. The officers of the company are, Norman D. Frisier, President, and Ralph Gates, Secretary and Treasurer, and P. O. Krottnauer, Superintendent.

INFLUENCE OF THE TEMPERATURE ON THE SETTING OF CEMENT.

To ascertain the influence temperature has on the setting, a cement has been chosen, that will set in one hour and 30 minutes under normal conditions, viz. a temperature of the cement, water and air of 61 F.

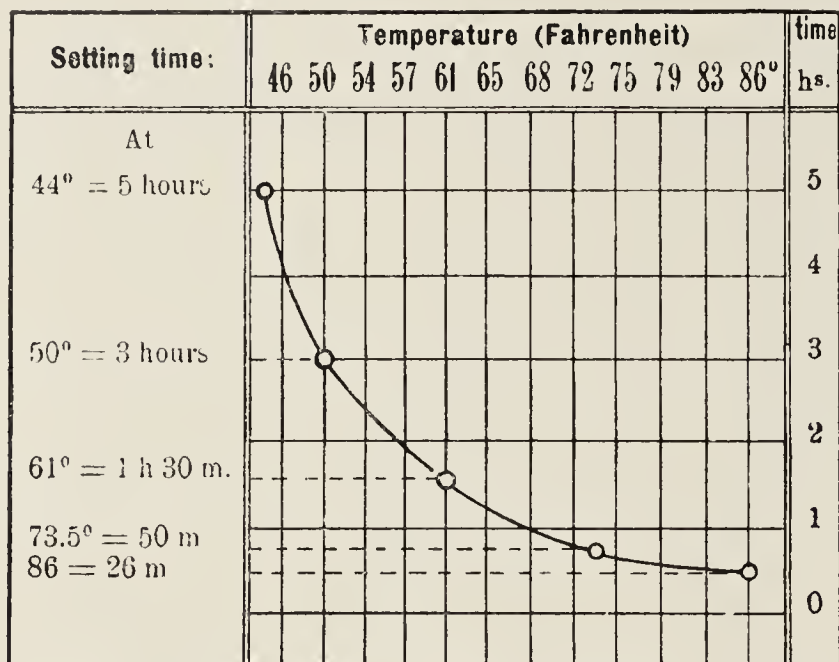
The temperature of the air remaining the same viz. 61 F. the temperature of water and cement chang-

which three are now under construction, with essentially similar methods and conditions.

The lower end of section No. 3 is 13.5 feet in diameter inside, and is constructed as shown in the accompanying cross section, which is typical of the whole sewer, other portions differing only in dimensions. In the construction of sections 2 and 3, Messrs. Bramley & Gribben, contractors, make the excavation with

The work is carried up grade. A 12x12-in. trench is dug in the center of the bottom, and a 6-in. clay drain pipe laid in it, with open joints surrounded with concrete. Above this, on the clay bottom, is placed a grillage of oak stringers and oak cross plank, upon which the heavy invert masonry is laid. This is concrete composed of 2½-in. stone, with all interstices filled with one-to-two natural cement mortar. In hand work there are about 26 men in the concrete gang, four of whom ram it in the pit. Concreting is continuously done ahead of the bricklayers, 18 of whom are employed in one gang, keeping pace with the excavators and concrete force.

The two-ring brick invert is laid to a semi-circular template, rising to the middle of the sewer. It has extensions at each end, with side pieces giving the exact angle of the concrete skewback. The haunches of the arches are laid up to within one course of the springing line, after which triangular frames, with the apex resting on the bottom of the invert, are set up 3 ft. apart and their tops connected by horizontal longitudinal boards at each end, forming benches on which the centers are wedged to exact position. Each center is composed of a semi-circular ring made of five sections of 2x8-in. boards, breaking joints and fastened in the usual manner with a tie piece across the lower diameter, from which there is a vertical brace in the center and one in the middle of each side through the center, from which another vertical piece is carried on from the bottom of the sewer. Lagging of 2x8-in. surfaced stuff in 12-ft. lengths is laid on the centers in 24



ing, the following results with regard to setting time were found:

Thus a pat of cement gauged at a temperature of 61 F. was slow setting, when the cement and water had a temperature of only 44 F. (winter temperature) whilst it was of medium setting at 65 F. (normal temperature) and even quick setting at 86 F. (high summer temperature).

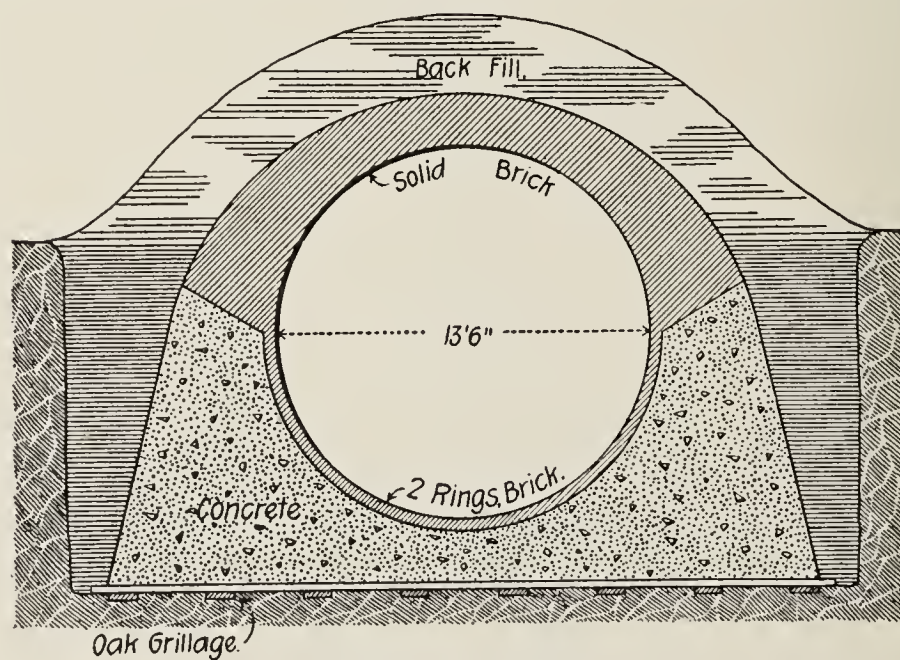
The above is taken from a booklet entitled "Quality Tests," and contains much valuable original matter relating to cement and its behavior under various conditions which apply in its use in the arts.

Published by Tulloch & Co., 4 Fenchurch Ave., London, E. C., England, and will be forwarded to any address on application.

WALWORTH RUN BRICK AND CONCRETE SEWER.

There is now being constructed in Cleveland a main sewer to carry off the sewage and rainfall from an area of about 3,000 acres. At the upper end its diameter is 8.5 feet, and at the outfall 16.5 feet. It is proportioned for an occasional velocity of 20 feet per second for maximum storm flow, and, as it is built in a street where there may be steam railway tracks and heavy traffic crossing above the sewer only three or four feet above its crown, it is built very heavily of high-grade brick and lined with a special hard-burned shale brick. It has a grade of 0.5 per cent. It is divided into four contract sections, of

pick and shovel, loading into steel dumping buckets, hoisted and conveyed by a 325-foot Lidgerwood cableway, mounted on the line of the trench. The head tower and engine house move on rollers on a broad-gauge railroad track, and pull the tail tower, which is laid flat and dragged along on the surface of the ground when it is moved, at intervals of a few days or weeks. The soil excavated is mostly a very stiff dry clay with occasionally muck and quicksand, and the trench is about 30 ft.



Walworth Run Sewer.

wide and from 8 to 38 ft. deep, averaging 17 ft. It is sheet piled, with plain 2x8-in. plank, and with tongued and grooved 3-in. plank. In the 17-ft. cut there are 8x8-in. waling pieces, with 8x8-inch transverse braces 9 ft. apart, with screw adjustments.

or 36-ft. sections; the braces are single 2x4-in. pieces set edgewise. All other material in the centering is 2x8-in. stuff.

Work has been begun with hand-mixed concrete, but a power plant is just being completed which it is ex-

pected will increase the present construction of 15 lineal feet a day to at least 25 ft. A 3-ton mast and boom derrick, with a 30-ft. boom, is mounted on a standard 10x30-ft. flat car, and guyed to it by wire cables on each side; each cable is secured to the edge of the car with a turn-buckle connection a little ahead of the mast, and, passing over sheave attached to its top, returns to the edge of the car a little behind the mast, and where it is connected with another turn-buckle. The concrete car is of special construction, with a 30x10-ft. platform, 14 ins. higher than usual and stiffened by longitudinal trusses. This platform carries a very rigid tower of heavy square timbers, in which is mounted an ordinary cubical concrete mixer fitted with an automatic water supply, which delivers any required quantity of water from an adjacent storage tank in the tower through the hollow trunnion. In the platform above the mixer is set a conical hopper, the bottom of which is closed by a balanced butterfly valve, so arranged as to be automatically locked by a counterbalance foot lever. A steel funnel is suspended below the hopper and runs back and forth on a horizontal track. This is inclined so that the funnel can be run under the mouth of the hopper to connect it and the mixer box, when the latter is to be filled; at other times it is rolled back out of the way. Measured quantities of material are filled into the hopper and automatically discharged by kicking open the foot lever attached to the latch, the valve closing by its own weight after the hopper is emptied. The mixer is operated by a 15-horse-power engine, and delivers through a chute and a hole cut in the bottom platform of the car, so that the concrete can either be conducted through a spout to the required position in the trench, or be received in a bucket and handled by the derrick of the derrick car previously mentioned. This follows close behind the concrete car, and is equipped with a 35-horse-power boiler and a two-drum Lidgerwood hoisting engine, beside a small independent single-drum engine to operate the bull wheel, which swings the mast. The concrete car travels on a standard gauge track, centered 10 ft. from the edge of the trench. Parallel with this track and close to it outside is another for the distribution of materials. The trench is drained easily through the 6-in. sub-drain, which empties into a dump 10 ft. deep. The contents of the sump are removed at intervals by hand pump. There are at present about 100 men employed on this section. The work on the other sec-

tions is conducted in a similar manner by Messrs. Wilson & Strack of Cincinnati.—*The Engineering Record*.

LOUISVILLE CEMENT TRUST.

Of the 1,700,000 barrels of cement manufactured in 1897, J. B. Speed and Belknap & Co., of the Western Cement Association, had as their quota over 70 per cent., the other seven mills in the association getting the following: Clark County mill, 5.38 per cent.; K. & I., 5.34; United States, 3.60 per cent.; Gheens, 3.90 per cent.; Ohio Valley, 3.80 per cent.; Charlestown, 4.18 per cent.; New Albany, 3.80 per cent. The Western Cement Association, of which eleven of the thirteen mills in Clark County, Ind., are members, cut the price of cement 5 cents on the barrel, and another cut is to follow if necessary. The object of the rate is to crush the independent companies who have refused to come into the trust and have for several months been cutting prices. On the other hand, the independent companies say they are ready for war and will meet this cut and any others that may follow. The price of cement will range from 40 to 60 cents a barrel, depending on where the product is sold. In localities where it comes in contact with other brands the price will be lower. Mr. Lewis Girdler, superintendent of the big Belknap mill at Sellersburg, said that the price of cement would continue to go lower and lower until the rival companies will be giving it away. The result of the cement war will not only affect the Louisville market, but as this vicinity is the greatest cement producer in the country it will extend to St. Louis, and other important markets.

LARGE CEMENT CONTRACT.

C. I. McDonald, the Pittsburg contractor, who has the United States government contract for building Locks Nos. 10, 11, 12, 13, 14 and 15 in the Monongahela river, closed a large contract recently with the Atlas Cement Company of New York through their representative, James L. Bernard, whereby they will furnish the 200,000 bbls. of Portland cement to be used in the construction of these six locks and dams. The cost of all these river improvements will be about \$1,000,000, while the amount involved in the cement is \$500,000. Contractor McDonald is at present building a storehouse at Morgantown, Pa., to hold 10,000 bbls. of cement. These dams and locks will all be constructed of concrete.

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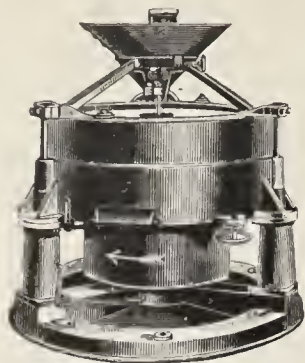
NEW IROQUOIS CEMENT MANUFACTURING COMPANY.

A company, to be known as the Iroquois Cement Manufacturing Co., has been organized to erect a factory and manufacture cement on a large scale at Bergen, N. Y. The capital stock is placed at \$1,000,000, divided into one million shares of \$1 each. The new company was organized in Buffalo under the laws of the state of West Virginia. New York and Philadelphia architects are now at work on the plans of the buildings. The buildings will consist of one large three-story steel building covered with corrugated sheet iron, a storehouse, mill, and engine and machine shops, also a large cooper shop, which will have a capacity of 1,000 bbls. a day. The latest improved machinery will be put into use in the factory and will start with a capacity of 500 bbls. of Portland cement a day. The main office will be located at Buffalo, N. Y.

The German cement industry during 1897 was prosperous and experienced a healthy growth, in common with other German industries. In the various trade centers German cements not only maintained prices, but were actually higher. All mills were run on full time on orders up to the close of the season. Several large factories are considering enlargement of their plants and new works are already going up in middle and south Germany. In the export market German cement has maintained its place, yet it must not be overlooked that our export seems to have reached its highest point, especially with the United States. Americans are endeavoring to become independent of other countries and have genuine Portland cement works with a capacity not to be underestimated. If the export of Portland cement should show a considerable falling off with the States then the northwestern Portland cement manufacturers now exporting to that market will be obliged to seek new markets in Germany, and prices will possibly be low again. While this yet lies in the far future, the society of Portland cement manufacturers through its officers will keep a watchful eye on all such questions.—*The Thonindustrie-Zeitung*, Berlin.

The Buckeye Portland Cement plant of Bellefontain, O., is being greatly enlarged and improved. Last year these works were much embarrassed by their output being too small for the demand.

D. A. Barnhart will superintend the Beach Cement Works at Binnewater, Ulster county, N. Y. the coming season.



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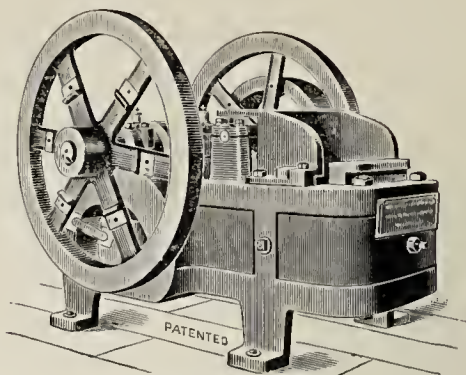
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Work of Crusher and Rolls Combined.

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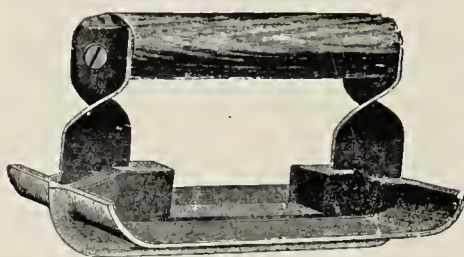


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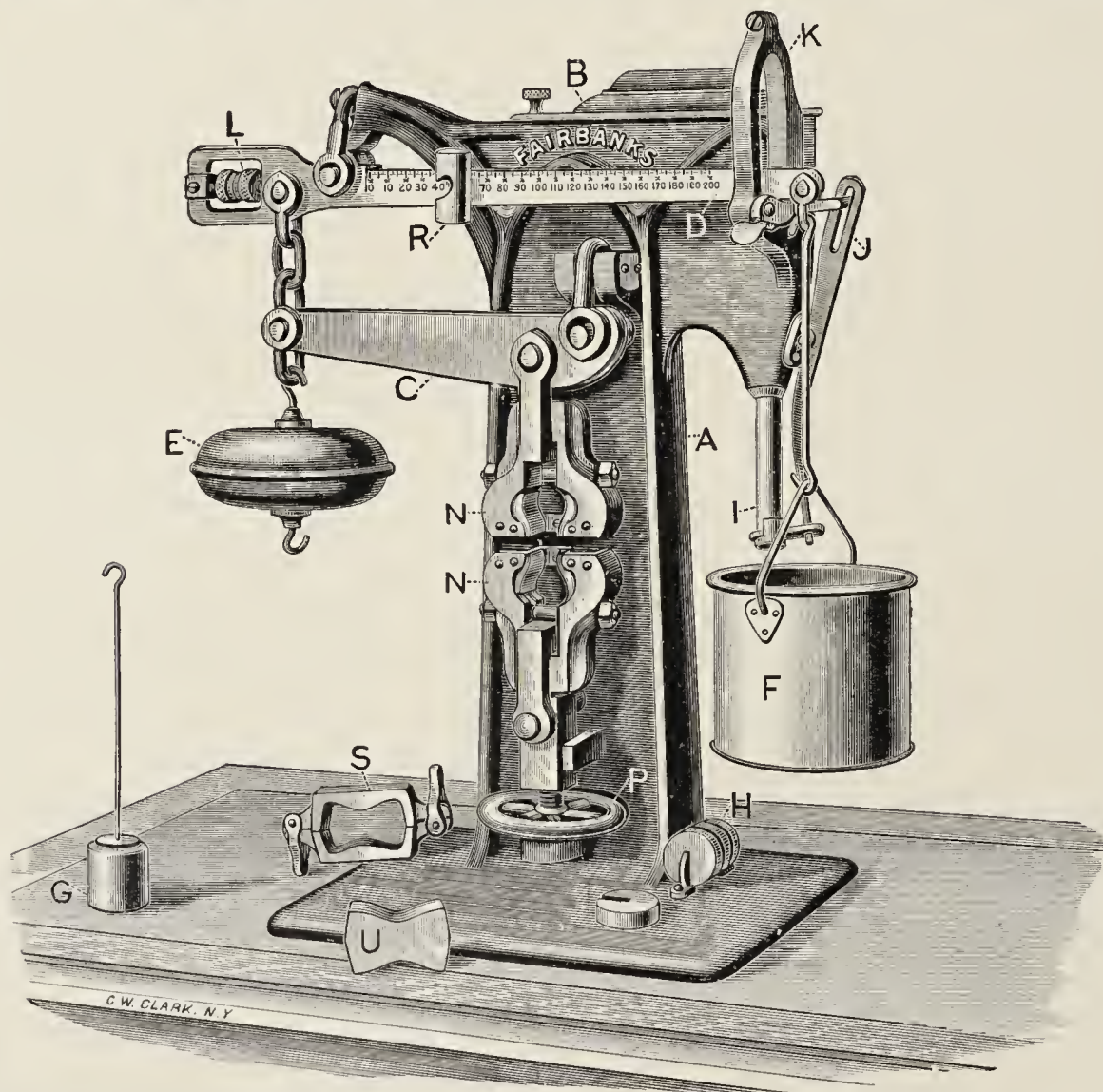
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The Company has all its territory districted in relation to resources, adaptability and advantages for manufacturing, and seeks to secure manufacturing plants and industries where the command of raw material markets and surroundings will insure their permanent success.

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The Chicago, Milwaukee & St. Paul Railway Company owns 6,168 miles of railway, exclusive of second track, connecting track or sidings. The eight States traversed by the Company, Illinois, Wisconsin, Northern Michigan, Iowa, Missouri, Minnesota, South Dakota and North Dakota, possess, in addition to the advantages of raw material and proximity to markets, that which is the prime factor in the industrial success of a territory—a people who form one live and thriving community of business men, in whose midst it is safe and profitable to settle.

A number of new factories and industries have been induced to locate—largely through the instrumentality of this Company—at points along its lines. The central position of the States traversed by the Chicago, Milwaukee & St. Paul Railway makes it possible to command all the markets of the United States. The trend of manufacturing is westward. Confidential inquiries are treated as such. The information furnished a particular industry is reliable.

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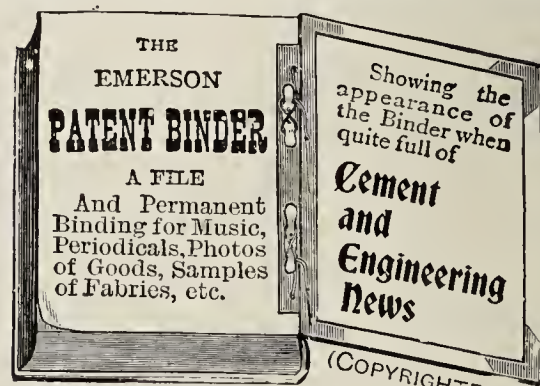
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NEW CHANNEL FOR DIVERSION OF THE DES PLAINES RIVER.—CHICAGO DRAINAGE CANAL.
Heidenreich Conveyor and Steam Shovel at Work.

STANDARD SAND FOR CEMENT TESTING.

By SPENCER B. NEWBERRY.

(Read, in part, before the Ohio Society of Surveyors and Civil Engineers, at the Annual Meeting, 1897.)

The methods of testing cement, especially Portland cement, have been the subject of study for many years by engineers in all parts of the world. In Germany and France exact specifications regarding cement tests have been established by the governments. In this country we have as yet, no definite official standards for testing, the only generally recognized authority being the report of the committee of the American Society of Civil Engineers. This report was presented in 1885, and consists chiefly of suggestions of a general character, and gives no precise instructions as to the methods which are to be followed. It is encouraging to note that the American Society of Civil Engineers has lately taken up the subject anew and has appointed a committee, consisting for the most part of engineers who have had special experience in cement testing, to investigate this important question. This committee has sent out circulars to a great number of engineers and others interested in cement testing, calling for suggestions as to the methods which give the best results in practice. It will be an immense advantage to the public if a set of rules be adopted by the society which shall give full and clear instructions as to the exact methods to be followed. At present every engineer follows his own methods and the results obtained by different experimenters can seldom be compared on any rational basis. Even the United States government has established no standard requirements, and the specifications sent out by government engineers for various contracts differ in a marked degree. In one set of specifications we find most severe requirements, while another set would admit cement of the most ordinary quality.

Probably the most complete official requirements are those of Germany, issued by the Minister of Public Works. These have been modified and perfected for many years, and in their preparation the government has had the aid of the Association of German Portland Cement Manufacturers and the Royal Testing Station at Charlottenburg. A pamphlet on cement testing, giving a full synopsis of the standard requirements of various countries, has been prepared by the writer, who will gladly furnish a copy to any one interested in the subject.

The German requirements specify that cements shall be tested with three parts normal sand. Tests of

neat cement are not recognized, since it is well known that a cement coarsely ground will give higher results when tested neat than the same cement finely ground. With sand, however, the fineness of grinding shows its effect at once in greatly improved tests. Further, many cements that are unsound and have a tendency to expand and go to pieces at long periods show remarkable neat tests at seven or twenty-eight days. With sand the rottenness of such cements is at once apparent.

The requirement that tensile and compression tests shall be made with three parts sand, by weight, rather than with one or two parts, has for its object the determination of the actual adhesive qualities of the cement. The normal sand contains about 40 per cent. of voids. In a mixture of one part of cement with two and a half parts of sand, therefore, the voids would be completely filled and the results would be a good deal like those obtained with neat cement. With three parts of sand, however, a certain part of the voids remain unfilled, and the true cementing power of the material, due to its hydraulic qualities and fine grinding, becomes apparent.

The "Normal sand" used in Germany is the clean quartz sand from Freienwalde on the Oder river, screened to pass a sieve of twenty meshes to the linear inch, and retained on one of twenty-eight meshes. The German requirements specify that Portland cement tested with three parts sand shall show at twenty-eight days a tensile strength of at least 224 lbs. and a compression of strength of 2240 lbs.

The briquettes and compression cubes for sand tests must be made with great care if uniform results are to be obtained. The German requirements give full details of the methods to be followed. Still more exact instructions are given in a recent report by M. Gary on the apparatus and methods used in testing cements at the Royal Testing Station at Charlottenburg. The German requirements specify that the cement and sand for five briquettes shall be mixed dry in a metal cup by means of a spatula. Water to the amount of 10 per cent. is then added, and the mixture thoroughly worked in the cup for at least five minutes. On the thoroughness of this mixing and working the results largely depend. Various machines for this purpose have been designed to replace hand labor, and are now under trial at the German Royal Testing Station. The briquettes are made by the Boehme hammer apparatus (each briquette receiving 150 strokes from a hammer weighing two kilogrammes) or by

hand. In the latter case a spatula of given weight and dimensions is employed. The molds are filled above the top and the mass rapped with the spatula until it appears elastic and water shows on the surface. The briquettes are kept in a zinc-lined box for twenty-four hours, then placed in water.

In the United States the only standard recognized is the crushed quartz used in the manufacture of sand paper, as recommended by the American Society of Civil Engineers. This quartz is very different from the German normal sand, as it consists of sharp, glossy splinters, while the sand is composed of nearly spherical grains, rough like ground glass on the surface. Comparative tests of the voids in these two materials gave the following results:

Standard crushed quartz, 20-30 mesh, voids, 48.2 per cent.

German normal sand, 20-28 mesh, voids, 39.0 per cent.

From this it would be expected that the standard crushed quartz would give lower results when used in testing cements. This, however, has not proved to be the case, as appears in the table given below.

One great drawback to the use of the standard quartz is its high cost, amounting to about \$10 per barrel. Its great difference in character from the sands used in practice is also considered by many to be a decided objection. It is therefore greatly to be desired that a standard sand should be selected in this country, coming from a deposit of such extent and uniformity as to insure a constant supply of unvarying material for a long period of years. The writer has made some search for a bed of sand of this character but has not as yet found a deposit which is comparable in extent or quality to the German beds at Freienwalde. Most deposits of clean sand are *too fine* and yield only a small percentage of sand of normal size, (20 to 30 mesh). Samples of sand from the north shore of Long Island, largely used for building purposes in New York City, and also of the sand pumped up from the bottom of the lake and bay at Sandusky, Ohio, were tested. The Long Island sand contains some opaque, soft grains, and is far from being as pure a quartz as the German. The Sandusky sand contains a few fragments of shells, which are an objection, as variation in the proportion of these would lead to uncertain results.

It may be that some reader of this article can suggest a deposit of pure, coarse-grained quartz sand, similar to the normal sand of Germany. If so the writer would be very glad to make tests of such sand in compari-

son with the German normal sand and the American crushed quartz. The following table shows the results obtained in testing a standard German and American Portland cement, with three parts sand of various kinds. Mixtures were made by weight, with 10 per cent. water in each case, and the briquettes prepared by hand. The molds were filled above the top and the briquettes lightly pounded in by laying a block over the mold and rapping lightly with a mallet. All tests were made by the same operator and especial pains were taken to keep the conditions uniform. The figures show tensile strength, average of four briquettes in each case, in pounds per square inch. The average weight of each set of briquettes at twenty-eight days, after drying, is also given. The latter figures show that a considerable variation in density took place in spite of all efforts to make the briquettes uniform.

SAND.	AMERICAN PORTLAND CEMENT.				GERMAN PORTLAND CEMENT.			
	7 days.	28 days.	1 year.	Average Weight. (grams.)	7 days.	28 days.	1 year.	Average Weight. (grams.)
Crushed Quartz....	315	373	447	127	238	265	375	121
Long Island Sand..	252	328	430	138	232	252	305	138
Sandusky Bay Sand	286	435	494	141	225	260	382	134
Ger. Normal Sand..	210	337	385	139	163	240	306	138

The above table shows that decidedly the highest results at long periods were obtained with the Sandusky Bay sand, also that the results obtained with the German normal sand were on the whole lower than the others.

The comparative results given by the various sands may be strikingly seen in the average tensile strength of all the briquettes made with each (24). This is as follows:

Sandusky Bay Sand.....	347 lbs.
Crushed Quartz.....	336 lbs.
Long Island Sand.....	300 lbs.
German Normal Sand....	274 lbs.

Laboratory of the Sandusky Portland Cement Co.
February 1, 1898.

OBITUARY.

Charles A. Berthelet, an old-time cement manufacturer, and heretofore largely engaged in the manufacture of cement sewer pipe and concrete construction work at Milwaukee, Wis., where his death occurred on the 16th inst. Mr. Berthelet was well informed on all matters relating to concrete construction, having made an extended tour through Europe in search of information on this subject. He was the son of Henry Berthelet who discovered and developed the cement rock at Milwaukee, and was associated with his father in that enterprise.

The coal elevator at Speed's cement mills, Clark county, Ind., was burned March 17, damage \$1,000.

NAZARETH PORTLAND CEMENT CO.

A meeting of the Nazareth Portland Cement company was recently held in the office of Dr. Irving A. Bachman, Trust Bank building, Allentown, Pa., when a permanent organization was effected by the selection of these officers: Dr. James P. Barnes, president; Dr. Irving A. Bachman, vice-president and general manager; Edgar T. Belden, secretary and treasurer. Directors: Charles D. Cramp, Philadelphia; E. H. Jones, Wilkesbarre; James P. Barnes and Irving Bachman, Allentown; Edgar T. Belden, Stamford, Conn. The company is chartered under the laws of Pennsylvania with a capital of \$300,000, and owns a 170-acre farm at Nazareth which has a rich bed of cement. Contracts for machinery and buildings are being awarded and will be pushed rapidly. Rotary kilns will be used and the plant will have a capacity of 1,300 bbls. per day.

THE HOWE'S CAVE CEMENT CO.

The consolidation of the Howe's Cave Lime and Cement Co. and the Howe's Cave Association to control the output of natural and Portland cement from that vicinity, under the name of the Howe's Cave Cement Co., has been recently effected and the largest stockholders are residents of Binghamton, N. Y. These are C. C. Jackson, Hon. I. T. Deyo, Charles C. Pratt, S. J. Hirschmann and J. W. Sturtevant. The officers of the company are: T. Henry Dumary of Albany, president; Charles E. Lee of Binghamton, vice-president and general manager; Charles H. Ramsey of Howe's Cave, secretary and treasurer; Sheldon Norton of Hokendauqua, Pa., superintendent.

Portland cement will be made from limestone and clay. About 400 acres of land are owned by the company. The manufacture of the natural cement is being carried on the same as formerly, and the machinery for the manufacture of the Portland cement has been purchased and will be installed as rapidly as possible. The machinery will be in operation by the middle of May or the first of June. Several large contracts have already been received. The company will start with a capacity of 300 bbls. per day and will increase the output to a 1,000 bbls. by next season.

Cement and Engineering News \$2 per annum.

CLINTON CEMENT CO'S. NEW MILL.

Messrs. Lathbury, Spackman & Bache of Philadelphia, Pa., have contracted with the Clinton Cement Co. to furnish plans and superintend the erection of a 300-bbl. cement mill. Rotary kilns and the latest improved grinding machinery will be installed together with conveying and elevating machinery and other labor-saving devices. The buildings will be fire-proof of steel construction throughout. The plant promises to be a model in every detail. The cement will be manufactured from slag and limestone burned in rotary kilns. This is an improvement in the method of producing cement from these materials and must result in the yield of a higher grade of cement.

STANDARD TESTING SAND.

The CEMENT AND ENGINEERING NEWS has frequent inquiries respecting standard testing sand and where it can be obtained. The highest grade is made by crushing pure quartz. All that part of the product which will pass through a No. 20 and remain on a No. 30 sieve is designated as standard, each grain being very sharp and angular with clear, bright surfaces, resembling glass in this respect. The sharp corners and angles dovetail and overlap when used in cement testing, resulting in bringing out the highest degree of tensile and crushing strength of which the cement is capable under the most favorable circumstances of yielding. This show of superior strength will vary uniformly in favor of one kind of sand as against another nearly 200 lbs. to the sq. in.

The Garden City Sand Co. of Chicago probably furnish the highest grade of standard sand in the United States, which they ship to engineers and others all over the country. Small samples will be furnished free to those desiring to test the same. They likewise publish a small pamphlet showing the influence of sand in cement testing, to be had on application.

The Minnesota Hydraulic Cement Co., with offices in Minneapolis made an assignment to John Kiesel. The company is new, having but recently begun the construction of a plant in Minneapolis. Liabilities \$5,457.

There has been more enquiry in the market, and a lot of orders have been taken for future delivery of imported cement at the following quotations at the ship's side, Montreal: English brands, \$2.10 to \$2.20, and Belgians, \$1.85 to \$2 per bbl. storage added.

TULLOCH & COMPANY'S MONTHLY CEMENT TRADES REPORT.

The active demand for English, German and Belgian cements continues, both for export and domestic consumption.

The actual business reported booked since the beginning of the year, it is generally conceded, is far above the average. Domestic buyers and consumers in foreign markets are cheerfully paying the advance in prices now asked, the opinion prevailing that if present active business continues, demand will have more than overtaken supply by the spring months, and that then delivery will become a matter of great difficulty with many of the mills.

Many of the London mills are now unable to accept orders for delivery before May, and it is commonly reported, are supplementing their own production by purchases from smaller works, wherever possible. Higher prices are now quoted for export, and leading brands are now asking as high as 6s. 9d. to 7s. per bbl. for early shipment.

In Germany the mills are enjoying a very brisk trade, especially in the case of those works located inland. Prices for local consumption have further advanced, but so far, this has not had the effect of limiting enquiries. Most of the works situated in Mid and South Germany have already sold the bulk of their production, and refuse to book further unless at an advance in price representing about 10 to 12 per cent. on previous rates paid.

In Southern Europe, the consumption of cement for public works will be enormous. As regards Great Britain, it is worth recording that consumers located in districts more easily accessible from continental ports are eagerly seeking to purchase Belgian and German cements, evidently being quite unable to secure their full complement from the London Mills.

In Belgium the artificial and natural cement mills have received large orders from abroad at a satisfactory advance in price, and the leading works now show no disposition to accept further business except at an advance on previous prices. There is a fairly good demand from North America, and whilst during the last two months there has been a set back in enquiries from Eastern markets, it is anticipated that cheaper money in the East will cause a general resumption in public works, and lead to renewed and larger enquiries for cement.

In conclusion, the position is such as, in our opinion, fully justifies intending purchasers securing them-

selves for at any rate, the bulk of their requirements during the present year, otherwise there is a distinct danger that during the spring and summer months they may have to go short of their full quantities.

TULLOCH & Co., Cement Exporters.
4 Fenchurch Ave., London, E. C., Eng.
February 23, 1898.

MARL LAND FOR SALE.

A fine body of first-class marl land suitable for the manufacture of a high grade Portland cement. This tract contains 200 acres, showing an average depth of 12 feet. On water transportation—reaching all points on the great lakes direct, with an abundance of suitable clay which may be dug from pits of dredged from submerged lands from three to five feet below the water surface. An abundance of cheap fuel; 12 feet of water at the docks now on premises. This marl deposit has been thoroughly tested and shows 96 per cent. of carbonite of lime. An excellent opportunity for a large plant. For information, address WATER TRANSPORTATION, care CEMENT AND ENGINEERING NEWS, Chicago.

The Maryland Cement Company, of Sparrow's Point, near Baltimore, Md., manufacturing Toltec cement from furnace slag, has an output of 200 bbls. per day and a capacity of 500 bbls. Orders are being filled for various parts of the country, and car lots for Philadelphia, Pittsburg, Cleveland and Dayton, Ohio and other Western points. The slag from Cuban ores are now used. When Cuban matters resume a normal condition a large export to that island is looked for as the ore carrying vessels usually return in ballast. Low freights can be obtained. A mill at Newark, N. J., with a capacity of 200 bbls. per day is producing the same material.

Benjamin Franklin says: "Men like to become acquainted before they begin to trade with each other." Advertising does it.

A subscription paper is now being circulated at Quincy, Mich., to raise funds to secure the location in the village of a Portland cement factory.

The J. J. Johnson Cement company of Omaha, Neb., capitalized at \$50,000, is licensed to transact business in Illinois under a capitalization of \$5,000.

The Bronson Portland Cement Co., of Bronson, Mich., will enlarge the capacity of their plant. \$100,000 is now in the company's hands for this purpose.

The Alpha Portland Cement Company received orders to hurry the work on all government orders for cement. The cement is to be shipped to Southern points.

The buildings of the plant of the Diamond Portland Cement Company at Middlebranch, just beyond North Canton, Ohio, are about completed. The new machinery will be in place and the plant in operation some time in April.

John S. Crawford, who has been in the cement business for years at 517 Walnut street, Cincinnati, O., made an assignment recently to Frank R. Morse. Assets \$45,000, liabilities \$22,500. The cause given is pressure of creditors and heavy mortgaged indebtedness.

The Cassadaga Cement company of Cassadaga, N. Y., have contracted to supply 30,000 bbls. of Portland cement to Buffalo parties between the months of April and October next. Improvements are under way looking to an increased output, warranted from the large orders now on hand. W. J. Budd, general superintendent, is placing the plant in excellent shape to meet the increased demand.

IMPORTS OF CEMENT INTO THE UNITED STATES.

WHERE FROM.	JANUARY.				SEVEN MONTHS ENDING JANUARY.			
	1897.		1898.		1897.		1898.	
	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.
United Kingdom....	4,220,952	13,655	13,858,907	45,740	143,919,659	467,068	102,537,817	340,507
Belgium.....	6,950,285	18,169	10,847,974	31,633	165,895,167	484,834	134,580,073	410,608
France.....			148,800	599	8,727,561	24,172	11,115,716	31,878
Germany.....	21,047,066	70,179	21,850,575	70,974	276,612,838	913,265	257,298,467	866,571
All Other Europe...	1,198,438	7,375	1,462,332	4,998	7,714,645	28,825	10,956,391	41,159
British North Am....	4,200	18			2,102,300	8,368	1,304,249	
Other Countries.....					804,100	3,871		
TOTAL.....	33,420,941	109,396	48,168,588	153,944	605,776,270	1,930,403	517,792,713	1,690,723
Domestic Exports of Cements, bbls.	3,657	6,396	2,378	4,186	18,224	33,415	31,921	53,729

There were 5,482,690 lbs. of imported Roman and Portland cements, etc., in the United States bonded warehouses on January 31, 1898, valued at \$16,986, against 11,801,979 lbs., valued at \$33,536, in January, 1897.

Imports of asphaltum or bitumen for January, 1897, were 4,284 tons valued at \$18,574; January, 1898—3,556 tons valued at \$8,587. For seven months ending January, 1897, 57,452 tons valued at \$183,516; for seven months ending January, 1898—61,927 tons valued at \$205,365.

CEMENT AND ENGINEERING NEWS.

(PUBLISHED MONTHLY)

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"This world belongs to the energetic."

Chicago, March, 1898.

CORRESPONDENCE.

We solicit correspondence on all matters of general interest to the cement trade in all of its branches. Engineering notes, public improvements, and facts and opinions drawn from practical experience will be welcome.

CONCRETE VS. TERRA COTTA FIRE-PROOFING.

Innovation is ever received with a hue and a cry, fosters a clash of ideas and a conflict of interests, with those who stand upon the ancient way and wish to continue in it. Concrete fire-proofing is an innovation on terra cotta and therefore must come in for its regular installments of misrepresentation from those who stand in the ancient way. In the city of New York concrete fire-proof construction has been hemmed in by antiquated legislation and therefore denied an open market. Every advance it has made has been through a series of technicalities administered by an unfriendly board of control whose minds seem warped in the interest of the local terra cotta manufacturers.

In order to bring the subject prominently before the public and establish the respective merits of concrete and terra cotta as a fire-proofing, a series of impartial tests were carried out by Mr. Constable, chief of the building department, resulting in demonstrating the superiority of concrete over terra cotta as a fire-proofing material in several vital points. The terra cotta manufacturers, who have large vested interests at stake, finding themselves standing on losing ground, are endeavoring to recover their former prestige by submitting the re-

sults of special tests of their material, made by engineers specially retained for the purpose, and in which the true spirit of fair competition does not enter. These special reports make a wonderful showing for terra cotta, as against concrete, and on being challenged, and fair open competition tendered by the concrete interests, the terra cotta manufacturer usually resorts from one shift and evasion to another, and finally declines the issue.

In the city of Chicago, where terra cotta and concrete fire-proofing meet on equal ground the respective merits of these two materials has been solved in a practical and business-like way by the Underwriters' Association by giving the lowest rate of insurance ever made in the city on warehouse property, embodying the latest form of concrete fire-proof construction. This carries a direct benefit to capital by reducing the fixed charges on the investment.

BRONSON PORTLAND CEMENT.

DICKENSON CEMENT CO., DISTRIBUTORS.

The Bronson Portland Cement Co. has entered the Western market and will contribute to its supply under the most favorable auspices, with an output of 400,000 barrels per annum of strictly high grade cement produced almost within hailing distance of Chicago.

Each package is subjected to a careful system of checks, tests and inspection before leaving the factory. This insures a practically uniform delivery of the highest grade of cement only.

Favored by low freight rates and excellent shipping facilities afforded by the Lake Shore & Michigan Southern railway, the company must at once assume a leading position as a source of supply for the entire Western States.

The Dickinson Cement company of Chicago, controls the entire out-

put. The business ability, tact, push and drive of the Dickinson Cement company is too well and favorably known to the cement trade to be enlarged upon. The consumer can rely upon and be assured of clean and exact business methods in dealing with them.

Advertising creates a demand for the article advertised. Catch on?

Every subscriber should have a substantial binder to preserve copies of The Cement and Engineering News. Price 85 cents, post-paid.

Mr. Alexander Scott, formerly with Eugene Caubert & Co. agents for the Vulcanite and North's Condor, will assume the management of the Wisconsin Lime & Stone Co.'s business at Chicago, carrying a general line of building materials, including lime, cement, concrete, stone, hair and fibre. Main office at Loomis and 15th place.

The Standard Silica Cement Company of Glens Falls, N. Y., have elected the following officers: President, S. G. Williams; vice-president, D. E. Moran; secretary and treasurer, W. B. Newcomer; directors, Wm. E. Spier, Byron Lapham, T. S. Coolidge and W. W. Maclay, Glens Falls; S. G. Williams, D. E. Moran, W. B. Newcomer, New York; Paul Larsen, Copenhagen, Denmark.

The cement mills in Clark county, Ind., are resuming operations. The Globe, Belknap's, Clark County and Standard mills are all running and the remainder will start very soon. The new mill being erected at Cementville by the Marblehead Limestone Co. & St. Louis people will cost \$75,000, and is expected to turn out a high grade of cement. Extra fine grinding will be a specialty with this mill.

Plans for the Iroquois Portland Cement company's new mill at Bergen, N. Y., are being prepared by Lathbury, Spackman & Bache, 1619 Filbert street, Philadelphia, Penna. The company is capitalized with a \$1,000,000, and is organized under the laws of West Virginia. At a meeting of the stockholders, recently held at Buffalo, N. Y., the following directorate was selected: Jacob Davis, Eugene Bertrand, Edward L. Davis, John C. Bertrand, John S. Hertie, A. D. Coffin and Wm. E. Webster. The officers are: Jacob Davis, president; A. D. Coffin, vice-president; John C. Bertrand, secretary; Edward L. Davis, treasurer; William E. Webster, attorney.

THE CONCRETE SUPERSTRUCTURE
OF THE UNITED STATES GOVERN-
MENT BREAKWATER, CLEVEL-
LAND, OHIO.

The building of a breakwater to enclose the harbor of Cleveland was begun by the United States government in 1876 and completed in 1883. This structure, 8,200 ft. in length, is constructed entirely of oak cribbing, ballasted with stone. A large part of the timbering, especially near the water-line, is now in bad condition. In the report of Lieut.-Col. Jared A. Smith for 1896 it was recommended that the work should be repaired by cutting away the old cribbing to a depth of 3 ft. below water level and building thereon a substructure of Portland cement concrete. This

broken stone 4. These blocks are made in plank moulds on the piers. When finished they weigh about 12 tons each. After hardening two weeks the moulds are removed and the blocks used like blocks of natural stone, their strength being greater than stone while their cost is not more than one-fourth as great.

Figure 1 shows the blocks lying on the breakwater where they are made, also the floating crane used for placing the blocks in position.

Figure 2 shows the operation of lowering the blocks into place on the old cribbing, cut off below the line of decay.

Figure 3 gives a nearer view of the same and shows how the blocks are held and lowered by means of the massive lifting crabs employed.

An experimental section of the work, about 200 yards in length, was completed in the fall of 1897. The results of exposure to the effects of the winter were eminently satisfactory, and the work will be pushed rapidly to completion in accordance with the plan above described.

It is expected that the whole structure will be completed by the end of the year 1899. The estimated cost of work, including repairs to the river piers, is \$860,000. For the illustrations accompanying this description we are indebted to the courtesy of Lieut.-Col. Jared A. Smith, engineer in charge of the work.

An advertisement in CEMENT AND ENGINEERING NEWS brings reward.



Fig. 1.—Floating Crane and Concrete Blocks lying on the U. S. Breakwater, Cleveland, O.

work was begun in the fall of 1897 under the direction of Col. Smith and is now being rapidly pushed forward. The contract for the work was let to Hunkin Brothers of Cleveland. The Medusa brand of Portland cement, made by the Sandusky Portland Cement Co. of Sandusky, O., was selected by the government engineers after comparative tests of a number of American Portland cements, and is being used exclusively in the whole work. It is estimated that nearly 80,000 bbls. of cement will be required to complete the structure.

The method of construction followed is to make blocks 4 x 4 x 10 ft. in size of concrete composed of Medusa Portland cement 1; sand 2; gravel 3;

After one tier of blocks has been placed in position, bringing the surface one foot above the water level, the structure is continued by erecting boxes of plank the full width of the breakwater, and packing concrete into these so as to form a solid mass. Alternate sections of convenient width are first filled, and after hardening, the planks are removed and the intervals filled in the same manner.

Figure 4 shows a section nearly filled, and crane just about to dump another load of concrete.

Figure 5 shows a section of the breakwater nearly completed with concrete parapet erected on the main structure.

REMARKS ABOUT THE TESTING AND GENERAL QUALITIES OF PORTLAND CEMENT, AND SOME RULES FOR USING IT SO AS TO GET THE BEST RESULTS.

(Continued from page 22.)

“Most writers on Portland cement have noticed the apparent deterioration of neat cement briquettes, both in salt water and fresh water. This is due to the changing of the molecular structure of the cement by age; the hardness and brittleness increasing and the elasticity diminishing. The crystals get larger, and there is an actual crowding which results in the falling off in the tensile strength in most cements from six months to a year. With briquettes mixed with

sand it is exactly the opposite. No falling off is shown, and good cement sand briquettes keep on increasing in strength almost indefinitely. The apparent deterioration of Portland cement mixed up without sand has been noticed much more of late, since the prevalence of higher grade Portland cements in the market. These cements obtain their maximum strength in a few months, and sometimes in a few weeks, whereas the slowly strengthening weak cements sometimes take several years to obtain their maximum, but this maximum although it has taken years to reach, is rarely higher than the strength of the neat high grade cements, at the end of a few months. With the advocates of cheap, weak cements, this has been a favorite

are largely influenced by temperature conditions. In the transactions of the American Society of Civil Engineers, in a paper read nearly twenty years ago, this subject was fully investigated, and the results can easily be obtained by careful engineers who really wish to conduct the testing of Portland cement on proper lines. In this paper it is pretty clearly brought out that the temperature of between 60° and 70° both for mixing the cement and keeping it either in air or water should be carefully preserved. A fall from this temperature, even if be only to 50° , sometimes diminishes the tensile strength for the seven-day period from 30 to 50 per cent., and consequently, where careless methods obtain, cement may be rejected that would otherwise come up to the tests

vision of the lieutenant in charge of the work, and these samples were sent to two of the best engineering laboratories in the country, where the results were found to exceed the strength called for by the specifications of the work by about 50 per cent.

"There are probably many similar experiences to the above in other places.

"With the keen competition that exists now in the cement trade a great deal has been said in favor of cheap cements, that while much weaker than the high grade Portlands on the seven and twenty-eight day tests, eventually, at the end of perhaps a year or two, show quite favorable results. If it were a question of testing these cements and keeping

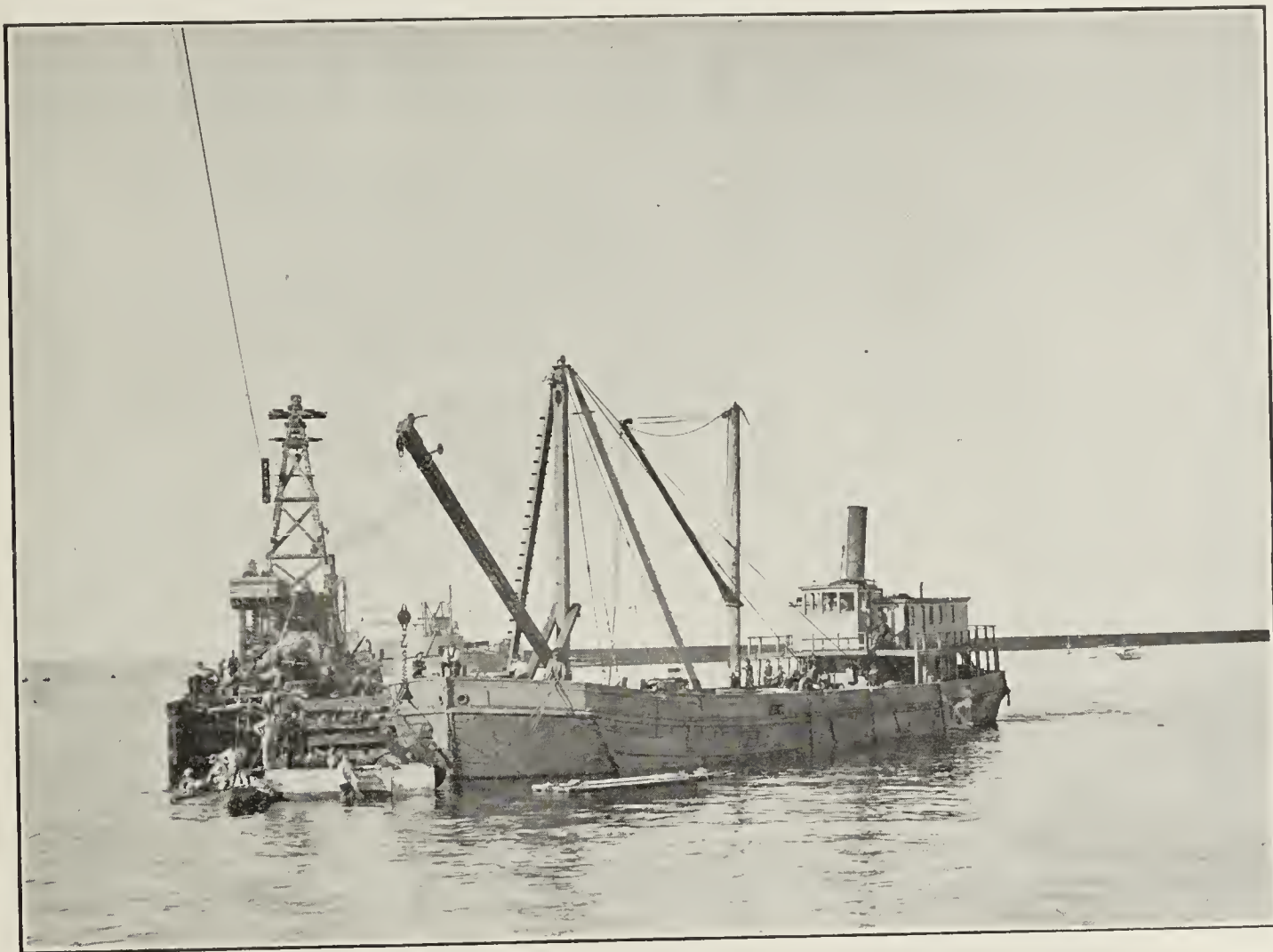


Fig. 2.—Operation of Lowering Cement Blocks into Place, U. S. Breakwater, Cleveland, O.

point, that the strength goes on increasing without any apparent retrogression; but where very important work is pushed forward, it certainly is more satisfactory to have the concrete develop its maximum strength in two or three months rather than wait for it several years.

"Notwithstanding the great difference in the tensile strengths of Portland cement, due to changes in temperature both at the time the cement paste or mortar is made, and in the temperature of the water or air in which the briquettes are kept great carelessness in this respect still prevails in the tests made throughout the country, and oftentimes very important issues are decided and cement accepted or rejected where the tests

called for by the specifications of the work.

"A recent case in point occurred on one of the large sea-coast fortifications, where the tests were made under the supervision of the United States Government Engineers, and it would naturally be supposed that they would be conducted according to modern methods. Instead of that, late in October, in an extremely northern latitude cement tests were made in a room without any fire and the brand of Portland cement that had been in use throughout the summer was now rejected for great deficiency in tensile strength. The Portland cement company furnishing this cement had average samples taken from the whole lot under the super-

them in a laboratory, perhaps their final strengths would justify the above claim; but as a matter of fact, in practice, all cement is subjected to conditions so much more unfavorable than surround it in a laboratory, that the highest testing cement at early periods can never be said to be too strong. We therefore think, from every point of view, a cement showing great strength in the early periods of setting is very desirable to enable it to withstand the strains such as now come upon concrete supporting our tall buildings in the large cities, and very generally in most of the engineering works in the country, which, with improved machinery, are now being pushed to completion so much more rapidly

than was possible heretofore.

"In all extreme conditions, such as the use of concrete in salt water, to stand the extremes of heat and cold, and where water tightness is required the high grade Portlands will in every instance be found to give the most satisfactory results.

"Of the American high grade Portland cements the Glens Falls Iron Clad brand attains a great tensile strength at the early periods. So much is this the case that on the twenty-four hour test (although generally an unimportant one, as indicative of future excellence) it frequently

"The use of Portland cement for ornamental sidewalks and drain and sewer pipe is extending enormously. In these industries so much care in executing the details is necessary that it is not possible to describe them briefly for the general users of Portland cement, so that they can always successfully execute the work. This is particularly the case with reference to sidewalks; where much practical experience is required, but a brief outline of the general method of laying a good sidewalk is as follows:

Compact or ram the earth on the site of the sidewalk to a level surface

sharp sand or crushed granite, mixed with a very little water and struck off to a very smooth surface with a straight edge. This mortar should be about 1 in. in thickness and should always be placed before the concrete below has set very hard. By using the best Portland cement, and following the above directions, faultless sidewalks will be the result; although, of course, it is possible to lay sidewalks much more cheaply than the above described one, but they will never be as satisfactory. With reference to the coloring matter usually employed in sidewalks in the cities,



Fig. 3.—Massive Lifting Crabs Employed in Lowering Concrete Blocks at Cleveland, O.

shows over 500 lbs. per sq. in. when tested neat—which is one-half of its maximum strength, and this exceptional early strength for certain kinds of work is very desirable.

"The United States, though slow to follow the example of European countries in the use of Portland cement, is now gradually adopting it for many purposes where other materials were formerly used. In no branch of building is this more the case than in the fire proofing floors now so necessary in the very tall buildings of the present day.

of about 16 ins. below the grade of the top of the sidewalk. Then place small stones or spalls not longer than 10 ins. on end and slightly inclined and cover the same with a thin layer of ashes or fine gravel. Turn the traffic of the street on this surface, and after it has been well compacted cover it with a layer of Portland cement concrete about 4 ins. thick, composed of 1 part of cement, 3 of sand and 6 of broken stone well tamped. On top of the concrete should be placed a mortar composed of 1 part of cement and 1 part of

it has been found that most of the coloring matter, especially ochres, are prejudicial to the strength and hardness of the pavement. Ultramarine is an exception, and 30 per cent. of this can be used without decreasing the strength of the sidewalk. Next to the Ultramarine, the German-town Lampblack is one of the best colorings to be used for the sidewalk surface on account of its durability and cheapness; and when about $\frac{1}{4}$ of 1 per cent. is added to the Portland cement, the pleasant gray color usually desired is the result. One

barrel of Portland cement will make about forty square feet of sidewalk described above. Driveways should be laid exactly the same as sidewalks except that the concrete course should be about 8 ins. thick instead of 4. In warm weather all concrete work, especially sidewalks, should be covered with damp cloths to prevent drying too quickly.

"Among the applications of Portland cement in practice which are likely to give rise to much disappointment is its use in freezing weather, and also for concrete deposited under water. With reference to the first, the practice prevailing along our northern border is the adding of salt to the water used in mixing the cement, in the proportion of about one pound of salt to four gallons of water, which prevents the freezing of the

with water, especially where there is the washing action of the tides and high currents, it should always be put into bags of burlap or some similar material to prevent the washing; and with this simple precaution good results can almost always be obtained.

"Much misconception exists as to the effect of age on Portland cement and the general preference seems to be in favor of having freshly ground cement. As long, however, as the cement is kept free from dampness, no reasonable length of time affects the cement detrimentally; in most cases it is improved thereby.

"For the purpose of scientific investigation Portland cements have been kept in barrels in storehouses where the cement was preserved from dampness, and after a lapse of fifteen years, beyond getting lumpy and be-

clean, sharp sand, few, indeed, are the cases in which this quality of sand is obtained; but if it were generally understood that a fine or loamy sand diminished the strength of the mortar from 30 to 50 per cent., more vigilance would be exercised in obtaining the sand.

"A very good practice prevailing on the continent to improve Portland cement mortar, where large quantities of sand are used, is the adding of lime paste. This has the advantage of making mortars unctuous under the trowel, and at the same time, by acting as a filler, slightly adds to their strength. For this latter reason it can also very advantageously be used to make water-tight mortar for cisterns and reservoirs, which is always a difficult operation.

"With the great improvements

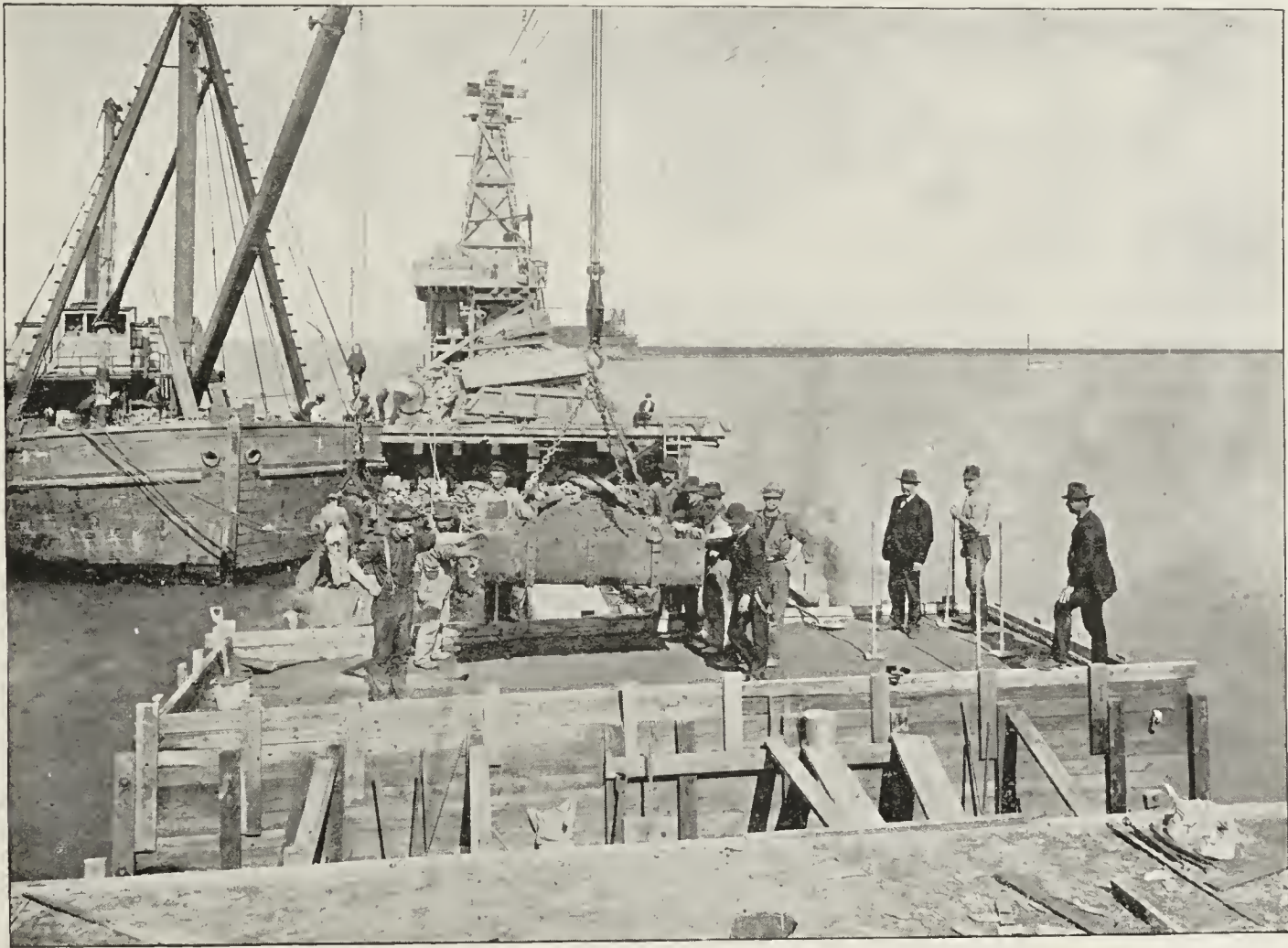


Fig. 4.—Crane Dumping Concrete in Section Nearly Filled, U. S. Breakwater, Cleveland, O.

water, even when the temperature is as low as zero, and does not materially affect the resulting strength of the concrete in the spring, as its setting is simply held in suspense during the time it is frozen, and the hardening begins again as soon as the temperature rises. In many cases, however, in order to make sure that the concrete will set the stone and sand and water are heated up to very high temperatures. This is prejudicial to the resulting strength in every case as it is only necessary to heat the stone and sand a little above the freezing point; the nearer they remain to it the better are the results obtained.

"With reference to mixing concrete

coming very slow-setting, no appreciable deterioration was observed.

"Many failures in Portland cement work, where the cause is laid to the cement, are really due to oversanding the mortar from the greed and avarice of the contractor. This is especially true of much of the municipal work done in our country, and could be very easily remedied and discovered by frequent laboratory analysis of the mortars, which would clearly show the actual amount of sand and cement used. Another cause of complaint in Portland cement mortar for which the cement is also frequently blamed is the use of poor sand, and although it is the practice in all good concrete specifications to specify

made in building in our large cities, Portland cement mortars are now used for brick laying where lime mortar formerly prevailed, and the cost of this mortar is frequently reduced by only adding the sand without lime paste, thereby greatly increasing the work of the masons who use it. The following rules for properly proportioning the lime, sand and cement, will be found useful. Proportions of Portland cement, sand and lime paste commonly used throughout Germany and Europe, where cheap Portland cement mortars are required:

PORTLAND CEMENT.	SAND.	LIME PASTE.
1 part	5 parts	$\frac{1}{2}$
1 "	6 "	1
1 "	8 "	$1\frac{1}{2}$
1 "	10 "	2

"The above proportions make an excellent mortar, which works easily under the trowel, and with the "Iron Clad" Portland cement it will be found that 6 parts of sand would be cheaper than Rosendale cement mortars, and nearly one-half again as strong at 7 and 28 days. If it is desired to make a water-tight mortar for cisterns and reservoirs, and where absolutely water-tight work is required, the following proportions are recommended:

PORTLAND CEMENT.	SAND.	LIME PASTE.
1 part	2 parts	$\frac{1}{2}$
1 "	3 "	1

These quotations are abstracted from a pamphlet entitled "Portland Cement for Engineering Works," by W. W. Maclay, C. E., which can be obtained free on application to the Commercial Wood and Cement Co., 156 Fifth Avenue, New York.

(To be continued.)

composition has been noticeable. A large amount of careful experimental work has also been done by a number of investigators, and from their results it is possible to state with considerable accuracy what proportion of the various constituents of cement will give the best and safest result.

Le Chatelier,* in 1887, proposed two formulas for Portland cement, giving the maximum and minimum proportion which may exist between the bases (lime and magnesia) and the acids (silica, alumina and iron oxide.) These formulas were stated in the very interesting paper by Richard L. Humphrey† on the Cement Laboratory of the City of Philadelphia, and in the discussion which followed the reading of this paper

letter received by him from M. Le Chatelier, in which the latter gives the latest form of his formulas as follows:

$$(1) \frac{\text{CaO} + \text{MgO}}{\text{SiO}_2 + \text{Al}_2\text{O}_3} \leq 3$$

$$(2) \frac{\text{CaO} + \text{MgO}}{\text{SiO}_2 - \text{Al}_2\text{O}_3 - \text{Fe}_2\text{O}_3} \geq 3$$

The original formulas are more or less ambiguous, while the last are clear and definite. *Equivalents*, and not weights, are indicated, and for this reason these formulas can be comprehended and applied only by those who have a knowledge of chemistry. With this knowledge, however, the degree to which a cement of known composition approximates to the above formulas may be easily calculated. Le Chatelier, applying these formulas to several

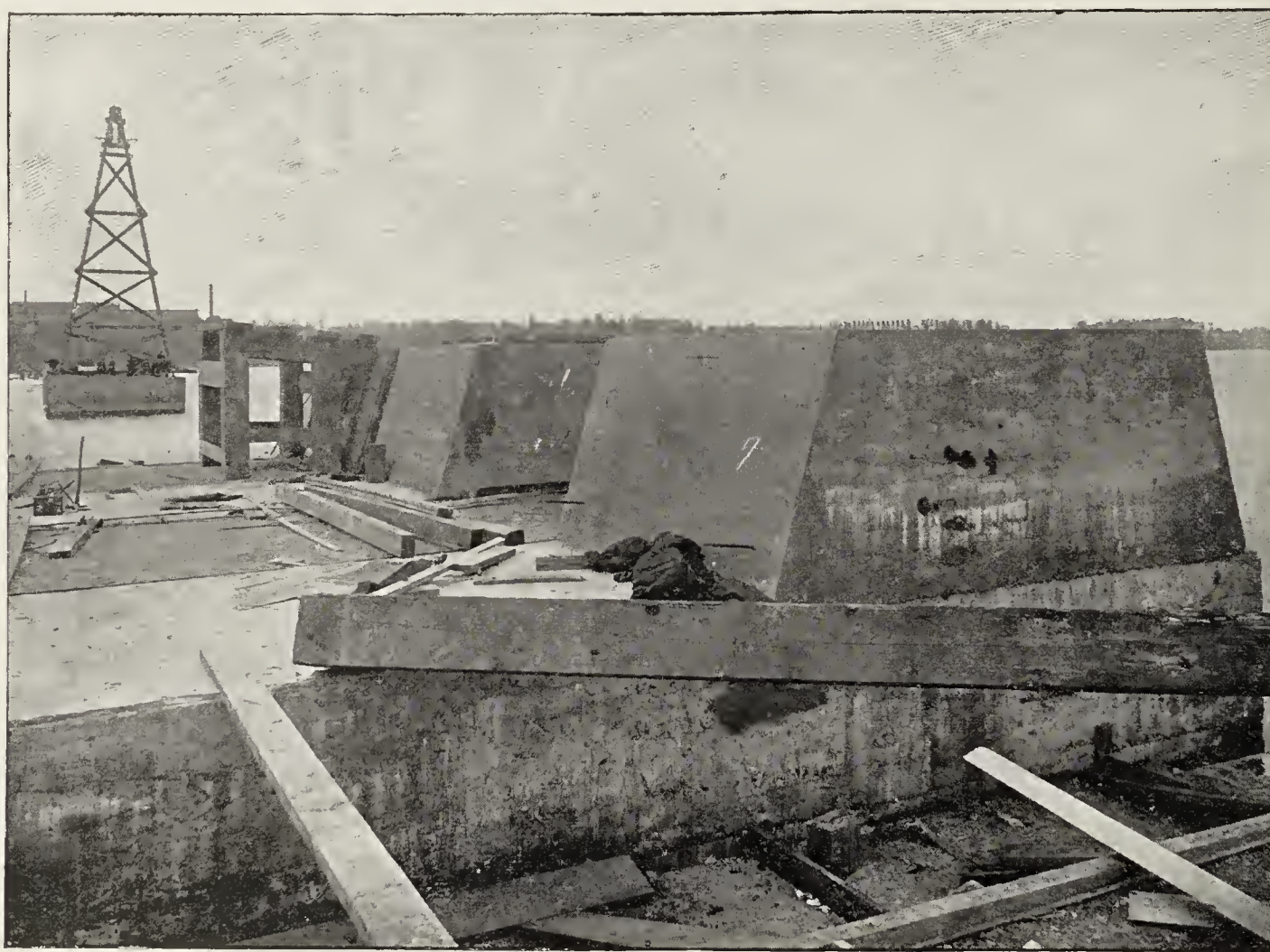


Fig. 5.—Section Completed and Concrete Parapet Erected on Main Structure, U. Breakwater, Cleveland, O.

LE CHATELIER'S FORMULAS AND THE HYDRAULIC INDEX.

By S. B. NEWBERRY.

The question of the correct proportion of lime and magnesia, on the one hand, and silica, alumina and iron oxide on the other, in Portland cement, has for many years been widely discussed by eminent authorities. For a long time it appeared impossible to give definite expression to this proportion, owing to the great variation in the composition of commercial cements. Within the past few years, however, the quality of the leading brands of Portland cement has been greatly improved, and with this improvement a much closer agreement in chemical

before the Engineers Club of Philadelphia. Unfortunately there appears to have been some confusion in regard to the correct form of the Le Chatelier formulas, and in the paper by the writer and W. B. Newberry‡ on the Constitution of Hydraulic Cements, these formulas are also incorrectly given. In Le Chatelier's original paper these formulas appear as follows:

$$(1) \frac{\text{CaO} \cdot \text{MgO}}{\text{SiO}_2 + \text{Al}_2\text{O}_3} \leq 3$$

$$(2) \frac{\text{CaO} \cdot \text{MgO}}{\text{SiO}_2 - (\text{Al}_2\text{O}_3 + \text{Fe}_2\text{O}_3)} \geq 3$$

In the February number of this journal Mr. Humphrey quotes from a

*Annales des Mines, 1887, p. 427.

†This journal, Nov. and Dec. 1897.

‡This journal, Nov. and Dec. 1897 and Jan. 1898.

French Portland cements obtained the following results:

Cement from	Formulas	
	(1)	(2)
Boulogne.....	2.22	3.60
Desvres.....	2.28	3.80
Frangay.....	2.55	4.05
Grenoble.....	2.40	3.90

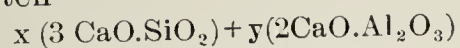
It is evident from the above figures that the Le Chatelier formulas are very indefinite, and that cements may vary immensely in composition and still fall within the limits which these formulas specify. Suppose, for example, we have a clay containing 65 per cent. silica, 15 per cent. alumina and 5 per cent. iron oxide and wish to make cement from it; using a carbonate of lime which, for the sake of simplicity, we will sup-

pose to be free from magnesia. Taking the extreme limits allowed by the two formulas, we find that the resulting cement may show a composition lying between the two following extremes:

	Formulas	
	(1)	(2)
Lime	70.9	64.1
Silica	22.2	27.4
Alumina	5.2	6.4
Iron Oxide	1.7	2.1
Ratio Lime to Silicates (by weight)	2.43	1.78

Anyone who has had practical experience in the manufacture of Portland cement will see at a glance that these two limits lie much too far apart to be of use as a practical guide. While the cement made with the maximum of lime allowed by the first formula will be somewhat overlimed, that containing the minimum of lime indicated by the second formula will be immensely over-clayed, and between these extremes will be found practically all the so-called Portland cements of commerce, good, bad and indifferent. In fact, the rough rule found in most books on cement, that about three parts of chalk or limestone are to be used with one part of clay, will be found a more accurate guide to the preparation of a correct cement mixture than the above formulas.

The great drawback to the formulas of Le Chatelier is their failure to adequately provide for the necessary variation in the amount of lime required with varying proportions of silica and alumina in the clay. As explained in the writer's paper on the constitution of hydraulic cements, the allowance of 3 equivalents of lime to one of alumina, in the first formula is excessive. If this formula be written



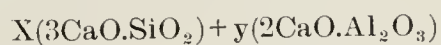
as proposed by the writer, it represents a maximum of lime which can be actually reached in practice with all clays, whatever the relative proportions of silica and alumina, provided the raw materials are extremely well mixed and finely ground together. Given these conditions, cements prepared according to this formula and thoroughly burned will be found constant in volume and safe in use, although the lime is higher than in most commercial cements. Certain of the best known German Portland cements, however, are very high in lime and correspond closely with the above formula. Mr. Lewis, in his discussion of Mr. Humphrey's paper, gave an interesting table of analyses of cements, with the hydraulic index and Le Chatelier ratio of each. Among these appear three "Published Analyses which are not Normal," which Mr. Lewis criticises as too high in lime. The first analysis

is that of the Germania Portland cement, taken from the circular of the manufacturers. These analyses, with the addition of the percentage of lime calculated from my proposed formula,

$X(3\text{CaO.SiO}_2) + Y(2\text{CaO.Al}_2\text{O}_3)$
are as follows:

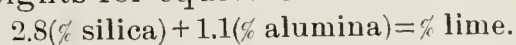
"PUBLISHED ANALYSIS WHICH ARE NOT NORMAL." (Lewis.)							
No.	Silica SiO ₂	Alumina Al ₂ O ₃	Lime CaO	Magnesia MgO	Hydraulic Index.	Le Chatelier's Ratio.	Percentage of CaO re- quired by N's formula
5	21.14	6.30	66.04	1.11	41	2.9	66.12
6	19.67	6.93	62.79	1.72	41	2.9	62.69
7	19.50	8.24	63.26	1.28	42	2.8	63.66

It will be seen from the above table that these three cements correspond almost exactly with the formula



They may be perfectly sound and safe, in spite of the high proportion of lime, provided the preparation of the raw material has been carried on with sufficient care.

The above formula has the advantage that it may be expressed in simple figures, indicating *weights* instead of chemical equivalents. Substituting weights for equivalents we have



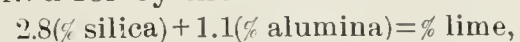
As already stated this formula represents the maximum proportion of lime that can safely be used, and this maximum can be attained only by the most perfect mixing and grinding of the raw materials. Under ordinary working conditions, however, the best results will generally be obtained with a proportion of lime not more than two or three per cent lower than that called for by the formula.

As already shown the *maximum* proportion of lime may, by means of the hot test, be fixed with considerable accuracy. The determination of the *minimum* amount of lime which is permissible is, however, much more difficult. The increase of the lime contained in a sound and strong cement may cause it to swell and crack. *Decrease* of the proportion of lime has a much less marked effect and merely tends to make the cement quick-setting and low in tensile strength. Greatly over-clayed mixtures give also a fusible clinker which may fall completely to dust on cooling. The temperature and duration of burning of mixtures too low in lime also greatly affect the result obtained. A short burn or a lower temperature may give a good result, while long burning or a high heat would give a cement of little or no value. This is shown in the rotary process of burning, in which the material remains not more than fifteen or twenty minutes at a high heat.

With this process the lime may be kept at least two or three per cent lower than with the kiln process, and high grade cement made from mixtures that would fuse or "dust" if burned in vertical kilns.

There is really no object in defining the *minimum* proportion of lime

which a cement should contain, since decreasing the lime does not make the product in any way dangerous, and merely causes a progressive falling off in quality and strength. The Le Chatelier minimum formula is certainly immensely too low in lime to be of practical value. In general it may be said that the more nearly the proportions approach those called for by the formula

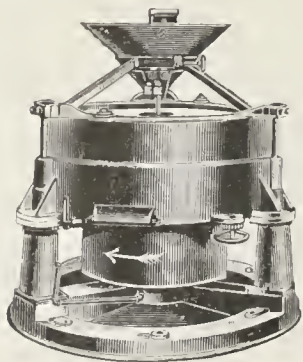


consistently with constancy of volume as shown by good hot tests, the better will be the quality of the product.

Another grave error in both the formulas of Le Chatelier is the introduction of *magnesia* as the equivalent of lime. The incorrectness of this has been clearly pointed out by several investigators, especially by Erdmenger,* who demonstrated that the true ratio exists between the acids (silica, alumina and iron oxide) and the *lime only*, and that magnesia must be stricken out of the Le Chatelier formula. Other German writers have pointed out that the proportion of lime plus magnesia, in the case of highly magnesian materials, may greatly exceed that called for by the Le Chatelier formula. The writer, as stated in his paper on the constitution of hydraulic cement, also proved this by preparing a cement containing 33 per cent. of magnesia, in which the clay was proportioned to the *lime only*. In this cement the ratio of lime and magnesia to silica and alumina, according to Le Chatelier's first formula, is 4.8, and yet the hot test was perfectly sound, and the pats of cement, after 6 months in air, show no sign of cracking.

The "hydraulic index" was proposed by Vicat to distinguish limes and cements of varying degrees of hydraulicity. As generally understood, it is a figure representing the number of parts by weight of silica and alumina occurring with 100 parts of lime and magnesia.

*Thonindustrie Zeitung, 1893, p. 317.



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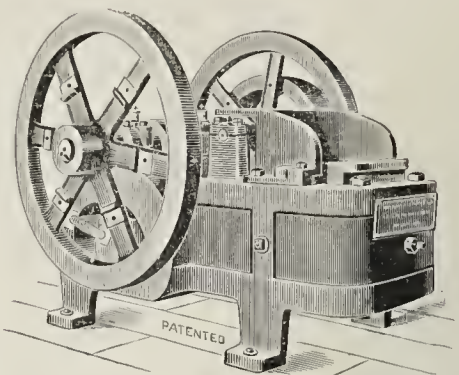
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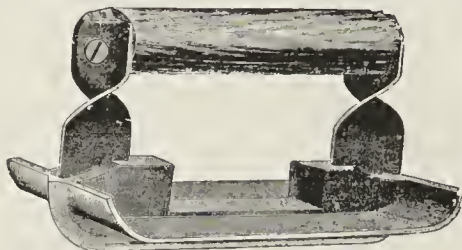


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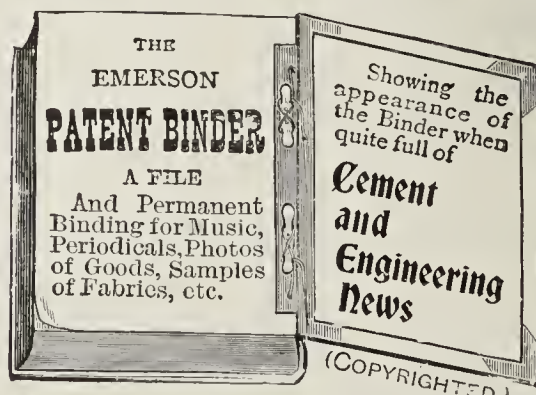
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Read April 6 before the Western Society of Engineers.
By FRANK B. ABBOTT.

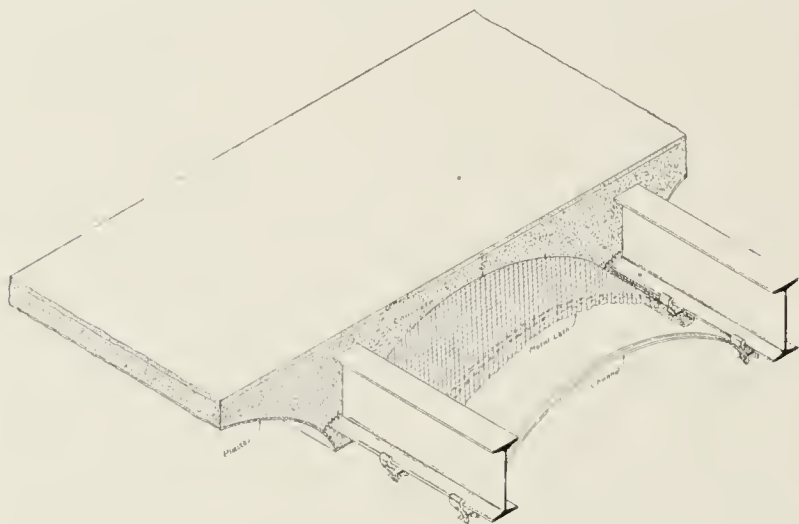
Our modern steel skeleton building marks an era in the history of architecture. In times prehistoric, in the Druidical epoch, the architect practicing without a license, but still wisely and well according to his light and with the primitive materials set up on end, at regular intervals, rough hewn or nature shaped posts of stone. Upon these posts and spanning the intervening spaces he laid other pieces of stone, upon these horizontal pieces he laid wooden poles covering the whole with leaves and grass, and right here the simple principles underlying all architectural form

15 and 16 of their transactions, show that in many instances the metal had been seriously attacked by corrosion, and there is little room for doubt that were the tile and terra cotta coverings removed from the steel skeletons of our great modern buildings we should find that rust has set up its dangerous work in many places. Simply putting a covering over the metal and calling this covering fireproofing does not insure the metal against corrosion, and sometimes unfortunately not against fire. Fire and corrosion then are the enemies of steel, the one bold, flagrant, irresistible, the other unseen, silent, constant and insidious. If we can keep these two enemies at bay we have a perfect and enduring

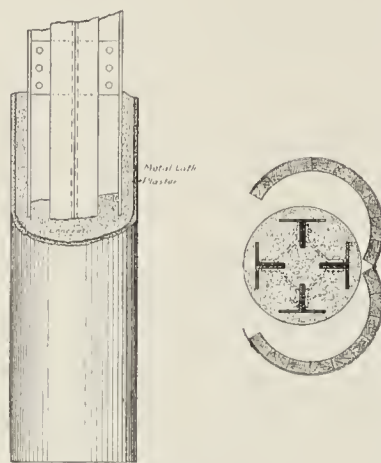
anchors embedded in the concrete of the walls of the coliseum of Rome when brought to light are as bright and untarnished as when new, and, coming down to our own times, we bury the steel beams of foundations in concrete to prevent the action of rust and the inside of the bottoms of the steel ships of our navy are protected from rust by a covering of Portland cement.

Therefore, if our fireproof material is concrete and wholly protects the metal from fire it will preserve it from rust. The proposition advanced herein then is to surround every column, beam, strut, or other structural member with concrete and not only surround the metal but envelope it on every side, leaving no air spaces externally or internally. What kind of concrete is best for the purpose? My experience shows that the best concrete is: First, one that is a fire resistant; second, one that will not expand under the action of heat; third, one that is light; fourth, one that is sufficiently strong for the purpose; fifth one that is high in lime. There is a number of substances which, mixed with mortar or cement will make concrete which will conform in the main requirements to that above described, but they are more or less dense and therefore heavy. In the 10-story manufacturing building, 171-173 Canal street, Chicago, the concrete fire and rust proofing is made of four of cinders to one of cement. These floors weigh about 35 lbs. per sq. ft.

The lime of commerce is one of the best fire resistants known and concrete for fireproofing purposes is best that contains the greatest proportion of this ingredient, consistent with strength. In the Druecker fireproof warehouse now under construction the columns will be protected by concrete made of one part of natural rock cement, one part lime putty and four parts cinders. This concrete material will be rammed into the internal cavities as well as entirely surrounding the columns, the nearest approach of the metal to the air being 4 ins. when the column is finished. After the concrete is set it will be covered with a metal lath on which will be spread a thick coat of dense, hard mortar. Wooden cylinders 4 ins. long and made of 2-in. staves hinged so as to open in the direction of their length will be set around the columns and the concrete rammed into place from the top. As soon as one 4-ft. section is concreted the second section is constructed on top of the first, and this process continued to the top of the column before the floors are put in, thus securing a continuous envelope to the column, without joints from



JOHN DRUECKER FIREPROOF WAREHOUSE—SECTIONS SHOWING APPLICATION OF CONCRETE.



was born, the column and the lintel. Through the ages that have intervened we have not improved much upon these principles. The column is a column still and the lintel is still a lintel. These two members are about all there is in a building aside from the finish and embellishment, for the beams and girders are only ramifications of the lintel, and struts and pilasters only undeveloped columns.

Modern science has brought steel to the front as the ideal building material, because of its great strength and capability of being worked into a thousand forms and when put together in a building it becomes as it were only one piece without joints or seams.

It is only a matter of time when all buildings will be constructed of steel where fireproof protection is sought. The fireproofing of wood or stone construction is simply a delusion and snare. Therefore when fireproofing is mentioned we mean steel and iron protected from the attack of fire. While steel is the most suitable building material it is liable to corrosive action of oxygen.

Investigations recently made by the American Society of Mechanical Engineers as to the condition of the steel in the frames of modern office buildings, published in volume

building.

To prevent the corrosion of the metal is not a difficult matter, it is only necessary to keep out oxygen present in the air and moisture by sealing the steel against the action of air and moisture. Painting the metal is but a short-lived protection, as wherever air currents occur along the steel members, as is frequently the case where hollow air spaces are left between the fire-proof covering and the steel, particularly where these air currents originate in basements or areas where there is moisture and warmth combined, the painting will protect the metal at best but a few months.

A fireproofing material of whatever kind to properly perform its work must entirely cover the metal, wholly envelope it and be of such nature and thickness to prevent the transmission of heat. This being so it follows that if this fireproofing material has the further quality of being impervious to air or moisture, we then can successfully resist the two enemies of steel, in buildings, with one material. History shows that iron embedded in cement and concrete is preserved from rust, for example, iron cramps laid in cement joints and used to hold together the lintels of the Parthenon, 2,000 years ago, have been found intact, and

basement to roof. The metal lath is used to provide a better key for the mortar finish and to protect the concrete from possible injury under high temperatures.

The steel will have no painting whatever, but will be cleaned of mill scale and other foreign substances at the building before concreting, since nothing should be put upon the steel to prevent the perfect adhesion of the cement to the metal, as the cement in the concrete settles about metal and deposits upon its surface a coating while the concrete is being rammed into place. The external columns will be covered with hollow bricks and the spaces inside this outside covering filled with concrete material, the same as other columns. In any building during a fire the point most fiercely assailed by the heat and flames is the floor construction directly above the fire and there has been plenty of evidence to support the statement that if the floor construction of any building is impregnable to fire, which may occur or originate in any story, then the damage from fire in such a building will be slight so far as the building itself is concerned. The fierce heat generated in burning buildings is caused by the floors burning away and thereby creating a draft through several stories.

In a private test made on several pieces of cinder concrete in a furnace under a boiler, the test lasting about forty minutes, the temperature was raised to the fusing point of wrought iron without showing any serious injury to the concrete blocks. These concrete blocks were 5x8x10 ins. and various grades of cement were used, the concrete being made of one part cement, one part lime, four parts cinders.

W. H. Birkmire, in his recent work, "The Planning and Construction of High Office Buildings," says on page 129: "Of the use of concrete in construction little need be said. It is a conceded fact by those authorities who have given the subject the most thorough and careful study that concrete as a fire-resisting material is unequalled. After the great conflagration in Chicago the committee who examined the effects of this fire reported that concrete was the most thoroughly fire-resisting material that had passed through the ordeal. Iron and steel when completely embedded in and protected by the concrete which forms around it in a homogenous cast, is undoubtedly better protected from the effects of the heat and corrosion than would be possible by any other method. In Europe where concrete has been used in building construction for centuries past its efficiency is better under-

stood than in this country. Many buildings are standing in Europe today which were constructed of concrete more than 500 years ago, and which have withstood the attacks of cold and heat for all these centuries and are yet in a good state of preservation."

Second only to making the construction of buildings impenetrable to fire is to confine the fire to the floor where it may originate. If the stairs and elevators are in fireproof enclosures the fire can only reach the floors through the windows. A new material, wire glass windows, in heavy metal frames, is shown, by recent experiments to be a splendid fire resister and stands heavy pressure. The relation that fireproofing bears to insurance is an intimate one and the insurance companies are close observers of conditions during fires, and their discernment of the value of fireproof material is constantly being sharpened by destructive fires. Comparisons are odious, but facts are stubborn things. In the Felix & Marston warehouse, built about four years ago, which building was fireproofed with cinder concrete in a general manner, as shown by details of construction exhibited here, the rate of insurance made by the insurance companies on the building was forty-five cents on a building filled from cellar to roof with a very inflammable material, namely wooden and woolen ware. This is the lowest rate in Chicago on a warehouse stored with this nature of stocks. Mill construction has proven a great disappointment to the architect, the owner and the insurance companies. This type of construction in large cities will undoubtedly soon become obsolete.

HIGH PRAISE FOR THE "CONSTITUTION OF HYDRAULIC CEMENT," BY S. B. & W. B. NEWBERRY.

"No piece of work on the chemistry of cement comparable with this by Messrs. Newberry has appeared within the last ten years, and we congratulate the authors on the sound method, well-directed industry and clear reasoning which are its characteristics."—*The Engineer*, London, Dec. 24, '97.

Copies of this work will be sent to any address on receipt of 25 cents by the CEMENT AND ENGINEER NEWS.

Government purchases of natural cement in the Ohio river cement region destined for the south via New Orleans is being hurried forward on passenger schedule time to meet pressing demands of the military authorities.

VOLUME TESTS OF PORTLAND CEMENT.

Written for the CEMENT AND ENGINEERING NEWS by
ANDREAS LUNDTEIGEN.

Civil Engineer Gary of the Royal Technical Testing Station in Berlin, Germany, gives in his report of 1897 some very interesting accounts of tests of Portland cement. The following are the principal points of what appeared in "Thonindustrie Zeitung" Nos. 3 and 26 of 1898.

There has been in Germany a higher standard of tests for Portland cement than in the neighboring countries but the manufacturers were for a time not satisfied with simply filling these requirements but entered into a rivalry in regard to strength. This had an unfavorable influence on the general usefulness of Portland cement and was commented upon in 1891 by Dr. Delbruck, president of the Society of German Portland Cement Manufacturers, and from that time a somewhat reactionary feeling in regard to high strength set in, so that to-day the standard strength (227 lbs. tensile and 2,270 lbs. compressive strain per sq. in. of mortar 1 to 3 in 28 days) is looked upon as proper and sufficient.

The author considers the volume tests of special interest and gives a great number of comparative tests showing the relation between some recommended volume tests and between these and other tests. The accelerated tests tried were:

1. THE KILN TEST AT 100° C.

Ten grams of cement is mixed with water to the standard consistency and made into a pat on a perfectly smooth plate of glass or metal which has been covered with a blotting paper. When set the blotting paper is removed and the pat kept in moist air for 24 hours, it is then dried on a metal plate at 100 deg. C. until no more water vapor escapes. (About 3 hours).

2. THE FLAME TEST.

Three hundred grams of cement is moistened with water and mixed rapidly, then formed to a ball in the hollow of the hand. The consistency is right when the ball appears greasy and when pressed from the side is somewhat elastic. The water is thus regulated according to the nature of the cement. The ball is laid on a plaster of Paris plate and when it is so hard that it cannot with ease be dented with the finger nail it is put on a thin iron plate and placed over a Bunsen burner. At the beginning the flame must not reach the plate, because small leaves of cement are loosened by the escaping steam when the heat is too strong. As soon as the part of the ball nearest to the

plate is somewhat dry the flame is increased until it (in about $\frac{1}{2}$ hour) covers the whole plate. At the end of 2 hours one can not with a cold glass plate placed directly over the ball discover any moisture, and the test is finished.

3. MICHAELIS' BOILING TEST.

One hundred grams of cement is made into a pat of the standard consistency and size, (1 cm. thick in the middle and thin towards the edges) and kept in a moist atmosphere 24 hours, it is then placed in a water bath which is slowly (in about one-half hour) brought to boil and kept boiling for 3 hours. The pat must be covered with water the whole time, but the addition of water should be gradual so as not to interrupt the boiling.

One hundred and four different cements were tested of which forty-two proved more or less faulty by the kiln test, thirty-four by the flame test and thirty-eight by the boiling test, while all the cements stood the standard pat test of one day in air and twenty-seven days in water of ordinary temperature.

The cements were also subjected to the different other kinds of tests such as time of setting, tensile and compressive strength, specific gravity, etc., but no harmony or agreement could be seen between these tests and either one of the accelerated tests.

Two cements failed to stand the kiln and flame tests, seven cements failed to stand the flame and boiling tests, eighteen cements failed to stand the kiln and boiling tests, thirteen cements failed in all three of the accelerated tests.

Of all the cements that through these volume tests proved inferior six did not come up to the required tensile strength and eight failed to stand the compressive test and did not show the right increase in strength, three of them proved all right both in regard to tensile and compressive tests and showed a good increase in strength. On the other hand many of the cements which stood all three of the accelerated tests failed to stand the required tensile and compressive tests.

The author then draws the conclusion (barring evidences from further tests) that if a cement fails to stand the three mentioned accelerated tests we may expect that it will be lacking in strength or otherwise fail to comply with the required standard of tests, but that we cannot with certainty say anything about the progress of hardening of the cement, the accelerated tests cannot therefore be used as decisive volume tests.

Dr. Prussing has in a different

way arrived at a similar conclusion concerning the Michaelis boiling test, he says:

1. Some Portland cements which were made from a homogeneous mass and well burnt and would prove faultless in air and water of medium temperature would show cracks in boiling test.

2. Portland cement mixed with 20 per cent. unslacked, underburnt cement would stand the boiling tests but come loose from the glass and curl up when kept in air.

3. In the boiling test the tendency to crack is not in all cements in proportion to the tendency to harden so that well burnt cements, which in ordinary temperatures would show a harmless increase in volume are put in a bad light as compared with light burned cements of less value.

4. The contraction of light burnt cements is at least equally as dangerous to the public as a well burnt cement that shows cracking only when boiled; the boiling test is therefore liable to lead to wrong judgments on the soundness of a cement.

As the Royal Testing Station will continue these accelerated volume tests we may expect in time to know what practical value they have.

The testing station does not as a rule hear anything of the cements after they have been used, but Mr. Gary has by correspondence obtained information of a number of them; thus he found that of ten cements which proved very doubtful according to the quick volume tests not one has so far showed signs of unsoundness, although they had been used in different ways. The mortars or concretes were not over seven months old but will be followed for at least two years.

The Illinois Steel company has contracted to deliver over 100,000 barrels of cement to the government for military purposes in the south.

MARL LAND FOR SALE.

A fine body of first-class marl land suitable for the manufacture of a high grade Portland cement. This tract contains 200 acres, showing an average depth of 12 feet. On water transportation—reaching all points on the great lakes direct, with an abundance of suitable clay which may be dug from pits of dredged from submerged lands from three to five feet below the water surface. An abundance of cheap fuel; 12 feet of water at the docks now on premises. This marl deposit has been thoroughly tested and shows 96 per cent. of carbonite of lime. An excellent opportunity for a large plant. For information, address WATER TRANSPORTATION, care CEMENT AND ENGINEERING NEWS, Chicago.

Mr. Franklin Bache, mining engineer, has retired from the co-partnership of Lathbury, Spackman & Bache. The business will be continued under the name of Lathbury & Spackman, at 1619 Filbert street, Philadelphia, Pa., as general designing and erecting cement plant engineers and consulting cement experts. The firm has several large cement plants under way in various parts of the country. The Castalia Portland cement works at Castalia, Ohio, near Sandusky, the Iroquois, at Bergen, N. Y., and the Clinton Cement company of Pittsburg, Pa. They likewise make a specialty of installing pulverized coal fuel plants and are pioneers in this line. The high efficiency and economic results obtained by its use leaves little to be desired. Manufacturers will consult their own substantial interests by taking advice and looking into the available data on the subject.

Benjamin Franklin says: "Men like to become acquainted before they begin to trade with each other." Advertising does it.

IMPORTS OF CEMENT INTO THE UNITED STATES.

WHERE FROM.	FEBRUARY.				EIGHT MONTHS ENDING JANUARY.			
	1897.		1898.		1897.		1898.	
	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.
United Kingdom....	3,802,892	12,339	705,600	3,252	147,722,551	479,407	103,243,417	343,759
Belgium.....	3,216,787	8,678	21,522,964	64,462	169,111,954	493,512	156,103,037	475,070
France.....	176,400	540	148,800	471	8,903,961	24,712	11,264,516	32,349
Germany.....	7,236,784	22,436	11,378,515	37,261	283,849,622	935,701	268,676,982	903,832
All Other Europe...	.....	.....	1,120,000	3,185	7,714,645	28,825	12,076,391	38,137
British North Am....	.....	.....	.....	.....	2,102,300	8,368	1,304,249	6,207
Other Countries.....	411	1	.....	.....	804,511	3,872	.....	.....
TOTAL.....	14,433,274	43,994	34,875,879	108,631	620,209,544	1,974,397	552,668,592	1,799,354
Domestic Exports of Cements, bbls.	2,664	5,562	1,902	4,187	20,888	38,977	33,823	57,916

There were 6,563,937 lbs. of imported Roman and Portland cements, etc., in the United States bonded warehouses on February 28, 1898, valued at \$21,105, against 10,403,600 lbs., valued at \$29,560, in February, 1897. Imports of asphaltum or bitumen for February, 1897, were 5,316 tons valued at \$10,254; February, 1898—3,529 tons valued at \$13,894. For eight months ending February, 1898, 62,768 tons valued at \$193,770; for eight months ending February, 1898—65,456 tons valued at \$219,259.

CEMENT AND ENGINEERING NEWS.

(PUBLISHED MONTHLY)

WILLIAM SEAFERT, Editor and Publisher.

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SUBSCRIPTION, - - - \$2.00 PER YEAR.
FOREIGN SUBSCRIPTION - - - 2.50 " "

ADVERTISING RATES SENT ON APPLICATION.

"This world belongs to the energetic."

Chicago, April, 1898.

CORRESPONDENCE.

We solicit correspondence on all matters of general interest to the cement trade in all of its branches. Engineering notes, public improvements, and facts and opinions drawn from practical experience will be welcome.

WAR AND THE CEMENT TRADE.

The practically defenceless state of our coast line defences in the past is fast being remedied by the war department by the use of Portland cement concrete, which has proved to be the ideal material for the construction of fortifications.

On every hand the government is pushing this line of construction with extraordinary energy, consequently creating an unusual demand for high grade cement which is likely to create a cement famine during the coming season, bringing the private consumer and government in sharp competition for the available supply. The mills have been approached by the government agents who are willing to contract for the entire output for an indefinite period. This would compel the mills to sacrifice the legitimate demands of their regular customers, which they cannot afford to do.

These conditions point to a temporary rise in prices which, under the circumstances the private consumer should willingly bear. The government demand for cement will not be confined to the United States. Our base of supplies on Cuban territory will need the protection of fortifications constructed of concrete. The large purchases already made on the part of the war department have had their effect limiting the present available supply. Contractors are placing their order earlier than usual and only feel safe when these are covered by responsible houses. So urgent has been the government demand that several large orders have

gone forward from mills to destination on passenger schedule time.

The outlook for the mills is gratifying indeed and the output for the season will run into extraordinary large figures. In the meantime the American people can feel themselves safe behind the cement bulwarks of the country. Upon the sea steel has displaced wood in our line of battle ships, while upon land Portland cement has displaced stone in our fortifications, and thus civilization advances.

COLORING CEMENT WARES.

"Use only sharp washed sand and clean water. Mix thoroughly.

The coloring material must not contain acids and must not affect alkalies.

Only mineral colors are fit to be used.

All liquid coloring matter destroys the alkalies of the cement.

Usually coloring matter weakens the strength, therefore no more should be used than is absolutely necessary—especially ochres.

Ultramarine is an exception. Thirty to forty per cent. of this can be used without the strength being materially lessened. In weak additions it even raises the strength.

A small per cent. of Germantown lamp-black is considered an advantage, as to ability to resist the elements; and on account of its cheapness (seven cents per pound) the small quantity needed and the pleasant gray color resulting, it is the usual coloring material used.

The kinds and quantities, in lbs. per hundred weight of Buckeye Portland cement usually used, are as follows:

Gray, used Germantown Lampblack,	$\frac{1}{4}$ lb.
Black, use Per Oxide of Manganese,	$\frac{1}{2}$ lb.
Blue, use Ultramarine.....	5 lb.
Green, use Ultramarine.....	6 lb.
Red, use Oxide of Iron.....	6 lb.
(The use of about 20 per cent. of this sometimes makes work disintegrate.)	
Bright Red, use Pompeian or English Red.....	6 lb.
Sandstone Red, } use Violet Oxide	
Violet, } of Iron.....	6 lb.
Yellow, } use Ochres.....	6 lb.
Brown, }	
White—Absolutely white work cannot be made with Buckeye Portland Cement. The whitest work can be made by using pure white slacked lime, free from iron and other coloring matter, and white sand or powdered marble.	

Color can be given to Buckeye cement by the use of certain chemical salt solutions, one added with the water to make the mortar, the other added to the surface—for instance, with the polishing material (as water

glass)—The reaction caused by the uniting of the two generates the color.

MAKING COLORED CEMENT WORK.

In the common kinds of colored cement work, only one color is used; it being either mixed with the mortar of the whole body, or only with the top coat, or a thin colored surface coat is made by dusting onto the fresh topping a thin layer of coloring matter mixed with cement and afterwards rubbing same to a smooth surface.

But there is a great variety of work in which different colors are used in the same piece; that usually made is called marble, figured or mosaic work.

Marble work is made by kneading different colored mortars together and rolling same out until the desired appearance is obtained.

Figured work is made in any colored geometrical pattern through use of forms of iron or zinc and colored mortars.

In the making of regular geometrical figures an iron form is necessary and a power press increases the economy and quality.

Mosaic work is of two kinds as follows:

1st. For Regular Mosaic Work.—Press into colored cement mortar small $\frac{1}{2}$ to $\frac{3}{4}$ in. colored cubes or pieces of cement mortar, tile, glass, marble, etc., cut to regular sizes, with the help of patterns laid out on the cement base. The latter should be about 2 ins. thick.

The ground if not covered as above may be natural cement color or any other color. The surface of this work is usually neither ground nor polished.

2d. In most any ground of colored mortar strew, set or mix with the mortar, small (about $\frac{1}{4}$ in. in size) colored pieces of marble, granite, tile, glass, etc. and variegated work called "Terrazo Work." Center figures are often inclosed in the "Terrazo Work," and occasionally a variety of figures are promiscuously scattered through it.

Particular treatment of the surface of this work is sometimes necessary to obtain a better finish or to deaden the sound. For this purpose a solution of silicate of soda is often used. Coloring water can be mixed with the latter. The surface may be ground with sandstone.

Moistening slightly with oil improves the surface of fine stones."

The above data is taken from a pamphlet issued by the Buckeye Portland Cement Co. of Bellefontaine, O., which can be had gratis on application. It contains much other practical data on the use of Portland cement in the arts with formulas for mixing concrete and mortar for various purposes.

LEHIGH PORTLAND CEMENT WORKS.

The latest addition to the number of cement works in the Lehigh Valley is that of the Lehigh Portland Cement company, who are about finishing up their plant and expect to be manufacturing cement by July next. Their works are of the most modern type; every new idea has been taken advantage of. The main buildings, which are entirely fireproof, comprise stone-house, stone-crushing and grinding room, kiln building and clinker-grinding room, covering 450 feet by 200 feet of ground, and the stock-house and packing house, 450 feet by 112 feet.

Their process of manufacture will be passing the stone through two Gates crushers then through a series of Mosser's crackers and rolls and Griffin mills, reducing the stone to an impalpable powder, in which state it will be conveyed to and pass through rotary kilns, where it is calcined, pul-

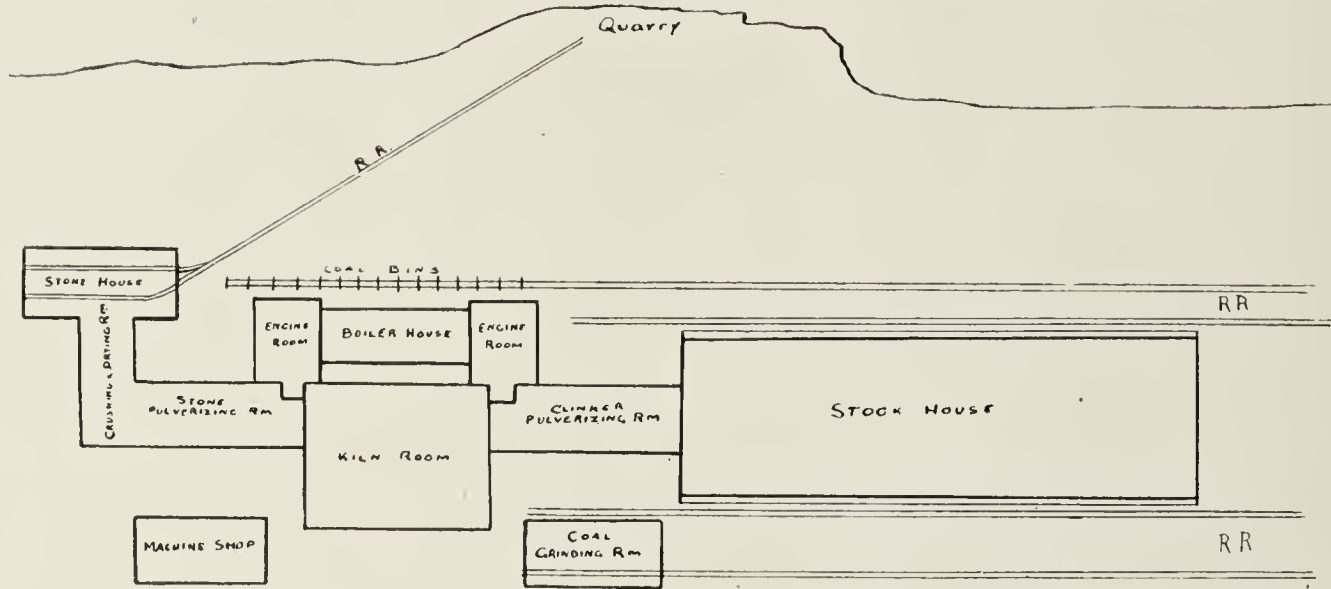
The company was formed in 1898, and has a capital of \$250,000, fully subscribed for. The superintendent, Mr. Chas. A. Matcham, is a practical man of many years experience. He erected the "Alpha Works," at Philipburg, N. J., in 1891, remaining there until October, 1897, when he left to accept his present position and to supervise the construction and erection of the plant. The experience gained by him in the erection of the Alpha works has been of material aid in making the plant of the Lehigh Portland Cement company fully up to date and one of the finest of its kind in the world. The works are located at Ormrod, Lehigh County. P. O. address, Allentown, Pa.

Production of cement in Canada for 1897 was: Natural, 85,450 barrels valued at \$65,893; Portland, 119,763 barrels valued at \$209,380.

Cement and Engineering News \$2 per annum.

been used in specifications for Portland cement. As stated by Mr. Lewis the city of Brooklyn recently specified an index not lower than 45 for a large quantity of cement required. The French official requirements state that cement containing less 44 parts silica plus alumina to 100 parts *lime* is to be regarded as suspicious. Candlot states that normal cements show an index of 42 to 48, while commercial cements often show 50 to 60.

In explanation of the confusion which seems to prevail in regard to all requirements referring to the chemical constitution of cement, it may be pointed out that most commercial cements contain more or less foreign material; chemical analysis, therefore, throws little light on the character of the true hydraulic material contained in them. The ashes of the fuel used in burning may amount to from one to five per cent.



PLAN OF LEHIGH PORTLAND CEMENT COMPANY'S WORKS, ORMROD, LEHIGH CO., PA.

verized coal being used as fuel. After calcining the clinker is cooled and conveyed to the clinker grinding room, where it goes through a process similar to that of the raw material, Griffin mills being used, finally being conveyed into the stock house as finished cement, and from which place it is packed by machinery.

Six Stirling boilers of 250 units each and two 500 horse power cross compound condensing Corliss engines, made by the St. Louis Iron and Machine works, will furnish the power.

The arrangement of the plant as shown by plan herewith given will be seen at a glance to be a decidedly good one, a continuous process being arranged from the time the stone enters the crusher to the time it reaches the stock house. The material is not handled otherwise than by continuous conveying machinery.

The capacity of these works when completed will be about 1,500 barrels daily.

LE CHATELIER'S FORMULAS AND THE HYDRAULIC INDEX.

By S. B. NEWBERRY.

(Continued from page 44.)

Here again, the insertion of magnesia as the equivalent of lime is a grave error and leads to the most deceptive results. Further, no account whatever is taken of variations in the relative proportions of silica and alumina present, though it is well known that a silicious clay requires much more lime than an aluminous one. For example, following the formula

$\% \text{ lime} = 2.8(\% \text{ silica}) + 1.1(\% \text{ alumina})$, with a silicious clay and a kaolin, respectively, we obtain the following:

Hydraulic Index.
Kaolin, (silica, 45; alumina, 40). . . . 50
Silicious clay, (silica 70; alumina, 15). 40

and yet both these cements would be of correct composition.

The hydraulic index has sometimes

of the total clinker produced. These ashes are high in silica and alumina and low in lime and considerably reduce the percentage of lime in the finished product. Candlot gives analyses of clinker (lumps) and dust from two different kilns of Portland cement.

	1		2	
	CLINKER	DUST	CLINKER	DUST
Silica.....	23.20	27.00	22.70	28.20
Alumina....	7.05	8.15	7.17	7.80
Iron Oxide..	2.35	2.05	2.18	2.50
Lime.....	66.10	61.15	66.35	59.48
Magnesia...	0.65	0.49	0.80	0.95
Sul. Anhyd..	0.80	0.92	0.68	1.18
Difference..	....	0.24	0.12	....
	100.15	100.00	100.00	100.11

These analyses show how greatly the ashes of the fuel have changed the composition of a portion of the product, causing it to fall to dust on cooling, in consequence of excess of silica. The lumps of clinker show a composition closely approaching that called for by the formula proposed

by the writer. The ground cement would, however, evidently be much lower in lime.

Another source of confusion in estimating the character of cement by the hydraulic index is the very general practice of adding ground gypsum in quantities up to 2 per cent. for the purpose of making Portland cement slow-setting. This tends to increase the apparent proportion of lime present. Addition of ground limestone (rag-stone), as largely practiced in England, would have the same effect in a much greater degree. Some manufacturers add a certain amount of ground slag to their cement. This would, of course, make the hydraulic index, or any conclusions drawn from chemical analysis, wholly deceptive.

For the reasons above stated, the writer is fully convinced that chemical analysis of commercial cements throws little or no light on the question of their quality or safety. To the manufacturer, on the other hand, who is in a position to analyze his raw materials, his cement mixture before burning, and his clinker, the question of the relative proportions of lime and clay required is of vital importance. The task of securing a correct and constant mixture, especially with new or varying materials, may be greatly lightened by the use of the proposed formula, applicable to all clays, representing the maximum amount of lime which can be used with a clay of known composition. The formula

$$\% \text{ lime} = 2.8(\% \text{ silica}) + 1.1(\% \text{ alumina})$$

may be modified for practical use so as to show at once the number of parts *carbonate of lime* to be used with 100 parts clay containing known percentages of silica and alumina. So modified, the formula will read as follows:

Parts carbonate of lime required for 100 parts clay = $5(\% \text{ silica}) + 2(\% \text{ alumina})$

Sandusky Portland Cement Co.

March 21, 1898.

U. S. letters patent, No. 601,007, covers the production of amorphous carbonate of lime and method of and apparatus for obtaining same. Herman E. Sturcke, New York, N. Y., assignor to the Aetna Chemical company, same place. As a new article of manufacture, carbonate of lime in the form of microscopically small, extremely finely divided, amorphous particles or loose aggregates thereof, having, when dried and powdered, a specific weight of from 78 to 94 grams 100 c. c. when the drying temperature does not materially exceed 212° Fahrenheit.

An advertisement in CEMENT AND ENGINEERING NEWS brings reward.

ISHAM RANDOLPH.

Chief Engineer Chicago Drainage Canal.

The Chicago Drainage Canal is one of the great engineering enterprises of modern times and will involve the expenditure of nearly \$25,000,000. The work is now nearing completion, about \$20,000,00 having been expended in its construction. When Mr. Randolph assumed the duties of chief engineer only about five per cent. of the work had been done. This was June 1893. Under Mr. Randolph's administration new methods of work and new machinery and labor-saving devices have been introduced greatly simplifying the handling of large quantities of material excavated. The methods employed and the economical results

Chicago & Western Indiana Ry., remaining with this company four years when he assumed the position of chief engineer of the Chicago, Madison & Northern Ry., a branch of the Illinois Central Ry. In 1888 Mr. Randolph located at Chicago and engaged in the practice of his profession up to 1893 when he was chosen chief engineer of the sanitary district of Chicago. This great work is now nearing completion under his direction.

James G. Clark of New Orleans has contracted with the war department to deliver 10,000 barrels of Portland cement to be used in the foundations for the disappearing guns now under construction in defence of Galveston.



ISHAM RANDOLPH.

obtained will influence future engineering undertakings wherever science, skill and economical methods are desirable.

In carrying out this work Mr. Randolph is virtually impressing his signature upon the face of the earth to endure and be read for ages to come.

Mr. Randolph was born in Virginia March 25th, 1848, and entered the employ of the Winchester & Strasburg Ry. In 1872 he was employed by the Baltimore & Ohio to make the Chicago extension survey of their line. In 1876 he became assistant engineer of the Scioto Valley Ry. and in 1880 received the appointment of chief engineer of the

The annual meeting of the Western Portland Cement company, of Yankton, S. D., was held at the Plankinton House, Milwaukee, Wis., on April 9. The officers elected are: Wm. Plankinton, president; D. J. Whittemore, vice-pres.; J. Johnston, Sec.-Treas.

The Mobile Coal company of Mobile, Ala., have closed a contract to deliver at Fort Morgan for the use of the United States government 12,000 barrels of Portland cement. Thirty thousand tons of crushed Tallahassee granite from the Coosa region of Alabama have been purchased and will be used in the concrete for fortification. The granite was originally ordered from Maine but could not be delivered in time.

CONCRETE MASONRY ON THE CHICAGO DRAINAGE CANAL.

The Spillway dam shown in the illustration was described and illustrated under construction in the September, 1896, issue of the CEMENT AND ENGINEERING NEWS, it is designed to take care of and provide an outlet for the flood waters of the Des Plaines river and prevent the water from flowing towards the Chicago river. It is 397 feet long. Instead of constructing this important work of stone masonry the engineers selected concrete as the most suitable material and this choice was made in the face of the fact that stone was upon the ground and was being quarried and removed as spoil by the contractors, no higher compliment could be paid to concrete construction than the facts narrated.

THE CONTROLLING WORKS.

In order to regulate the flow of

Utica cement being largely used in the concrete and stone facing. The work is now under contract for the lump sum of \$120,000, not including the gates.

The bear trap forms a part of the controlling works the masonry being of similar construction so far as relates to the materials used, concrete with stone facing, and has been contracted for at a lump sum of \$58,000. The bear trap mechanism will not be installed until the increased capacity of the canal calls for increased openings.

The Dickinson Cement company of Chicago are disposing of the entire output of the Bronson Portland Cement company plant. The mill is far behind on orders and is constantly increasing its capacity. This cement is giving excellent satisfaction.

Advertise in these columns for results.



Spillway Dam in Flood Time.

water through the canal towards the Mississippi from Lake Michigan a dam with a series of gates has been constructed on the Stoney Gate type, set between massive concrete piers faced with stone, working in steel guides. These gates hoist vertically and give a clear opening of thirty feet between each pier. Each gate weighs 60,000 pounds and are counter balanced and operated by machinery whereby two men can raise and lower each gate with comparative ease. The piers between each gate are 30 ft. long and 49 ft. high and 8 ft. wide, increasing to 16 ft. at the base. There are 15 gate openings, 7 only being provided with gates, the remaining 8 gate spaces are filled in with concrete to be replaced with gates as the capacity of the canal is increased. Nearly 11,000 barrels of natural cement were used in the work,

REMARKS ABOUT THE TESTING AND GENERAL QUALITIES OF PORTLAND CEMENT, AND SOME RULES FOR USING IT SO AS TO GET THE BEST RESULTS.

(Continued from page 40.)

"For brick work, the 'Iron Clad' Portland cement mixed with 6 parts of sand and one part of lime paste is recommended, although the cheaper proportion of one part Portland cement, 8 parts of sand, and $1\frac{1}{2}$ of lime paste will give excellent results.

"The advantage of all the above mixtures for cheap Portland cement mortars over Rosendale mortars, is the fact that they are all slow setting, and can be kept for several hours on the mixing board or on the work without injury; while Rosendale cement mortars are very generally quick setting, and after a very little interval has elapsed from the time of

mixing before they are deposited in place they become comparatively worthless.

MIXING PORTLAND CEMENT MORTARS AND CONCRETE.

"Portland cement mortar and concrete can be mixed much more thoroughly and economically in well-designed mixing machines than by hand; but no type of machine should be adopted, unless it admits of the following: 1st. The dry mixing of the cement and sand in the proper proportions; 2d. The thorough mixing of the cement mortar after the water has been added; and 3d. The mixing of the cement mortar with the broken stone or gravel. Most of the concrete mixing machines in use perform the first two operations at the same time, and some machines even are arranged to mix the cement, sand, water and broken stone all in one operation. Mixing the cement mortar and making concrete by hand labor is much preferable to using these imperfect machines.

MIXING CONCRETE BY HAND LABOR.

"Spread out on a smooth platform the proportional amount of sand to be used with one barrel or one measure of the cement. Add the one barrel or one measure of cement, and thoroughly mix the two until one color is shown. Then add the exact amount of water by sprinkling, and again thoroughly mix until the mortar is brought to the state of a stiff, plastic mass. The amount of water necessary to use in order to make a stiff, plastic mortar must be ascertained by experiment for each kind of cement, and this is very important, as the strength of the mortar is very much weakened by adding a very little more than the necessary amount. It should be remembered, however, that even with same cement, the amount of water necessary to make a stiff mortar varies with the temperature and degree of moisture in the air, and the dryness of the sand. If great strength is required, only enough water should be used to make the mortar resemble damp earth, and this when properly rammed in thin layers will show a little mortar on its surface.

If the concrete is made so dry that by ramming it does not quake, and hardly any water rises to the surface, there is always danger of the interior being honey-combed, and that every particle of cement will not get its proper amount of water, and therefore no chemical or setting action will take place; this is rather more dangerous than to have a slight excess in the amount of water, which, of course, has been shown by laboratory experiments to weaken the mortar, but at the same time all wet mor-

tars eventually will get quite hard, while with the dry mortar there will always be some portions that will never set. On the whole, the concrete that quakes under the rammer is much the safest.

"A fact not generally observed in concrete work is that all Portland cement concrete work above water contracts in setting, while under water it expands. Provision for this is usually made in monolithic work by placing vertical joints at regular intervals, and at right angles to the longer dimension. The depositing of loose or plastic concrete under water should be avoided, as there is always danger of the cement being washed out, and the materials being deposited in layers according to their respective specific gravities.

"Concrete blocks made on shore, coffer dams to enclose the work, and to allow the concrete to be made out of water should be resorted to in preference.

"Recently the subject of cement testing has been made the occasion for several congresses in Europe, to which representatives were sent from all the leading testing laboratories in Germany, France, Austria, Belgium, and Switzerland. The full report of these congresses has been translated into English by Mr. G. C. Henning, and is to be found in the proceedings of the American Society of Mechanical Engineers. The results of the tests recommended were generally on the line of those already given in the official German rules.

"The principal test to determine the strength of Portland cement is the tensile strength of briquettes, 1 part of cement with 3 parts sand, and there seems no reasonable doubt that this test will gradually become universal, owing to the inherent imperfections of the neat test."

The Atlas Cement company manufactured 700,000 barrels of Portland cement in 1897.

The Maryland Cement company, of Sparrows Point, Md., has just finished the delivery of 10,000 barrels of slag cement to the government for use on fortifications under construction on Chesapeake Bay near Baltimore.

Several of the Lehigh Portland cement mills have contracts with the United States government for the delivery of 1,000 barrels of Portland cement per day, for use in constructing coast line fortifications, all moving forward under rush orders. The government is picking up all the cement it can obtain throughout the country, without quibbling on prices, for use in strengthening our national defenses.

COMMITTEE ON THE PROPER MANIPULATION OF THE TESTS OF CEMENT.

BOSTON, Jan. 15, 1898.

DEAR SIR:

The Committee on the Proper Manipulation of Tests of Cement earnestly requests that you will give full and careful consideration to the following questions, and that you will, as soon as convenient, send to the chairman complete and explicit replies, giving the result of your experience and the embodiment of your views. Any additional suggestions or information bearing upon the subject which you may desire to communicate will be thankfully received by the committee.

This circular has been sent to every member of the American Society of Civil Engineers, and to many others, but in order that it may reach everybody whose opinion will be of value, you are requested to mention

Institute of Technology, Boston, Mass.

SAMPLING.

1. In the works which you have carried out, how much cement have you been willing to accept on the results obtained with a single sample?

If this depends upon the kind of work or reputation of cement, please indicate.

2. What method do you recommend for obtaining a sample from a package?

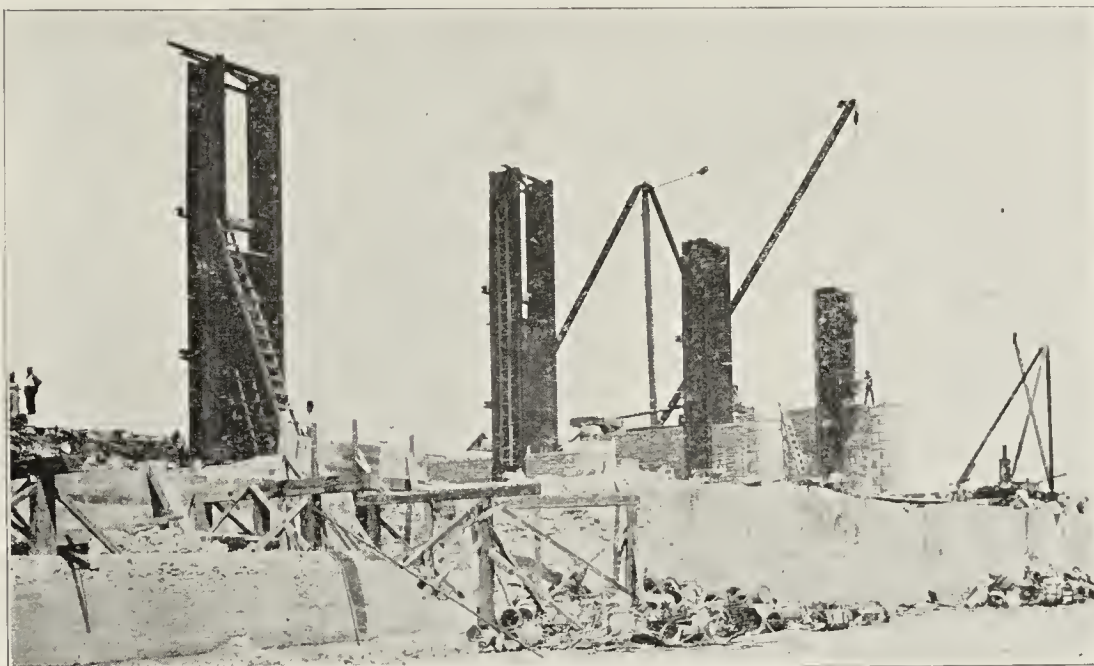
3. Do you mix cement taken from several packages to obtain a sample to use in testing, or are the samples from the several packages kept distinct?

CHEMICAL ANALYSIS.

4. When do you consider a chemical analysis essential or desirable?

5. What elements or compounds should be determined?

6. What do you consider the best methods of determining these com-



Piers and Gate Guides—Controlling Works Under Construction.

the names and addresses of any persons, not members of the society, who, in your opinion, should receive it, and who will be likely to assist the committee in its work.

You are also requested to send with your answer copies of any specifications for cement which you may have used, or any other information bearing upon the subject which you think would be of interest.

As the duties of the committee will require considerable time and labor, you are earnestly requested to respond as promptly as is consistent with a careful consideration of the questions asked.

Yours very truly,

GEORGE F. SWAIN, *Chairman*.
O. M. CARTER, W. B. W. HOWE,
ALFRED NOBLE, L. C. SABIN,
G. S. WEBSTER, HERBERT W. YORK.

COMMITTEE.

Address Prof. Geo. F. Swain, Mass.

pounds with sufficient accuracy?

MICROSCOPICAL TESTS.

7. Are microscopical tests of value, and, if so, when?

8. What power microscope is required, what observations should be made, and what are the indications?

FINENESS.

9. What sizes of mesh should be used in testing fineness of Portland cement? What for natural cement?

(If these questions are answered by stating the number of meshes per linear inch, please mention, also, the size of wire without reference to any wire gauge.)

10. What should be the diameters or sizes of the screens?

11. How large a sample should be tested?

12. Should any machine for shaking be used, and if so, what form, and what should be its manipulation?

13. How long should the shaking be continued?

14. Should there be any difference in manipulation for fine and coarse screens, or for different kinds of cement?

APPARENT DENSITY OR WEIGHT PER CUBIC FOOT.

15. What is your opinion of the value of this test?

16. What apparatus do you prefer, and how should it be used? (Please state any special precautions to be observed.)

TRUE DENSITY OR SPECIFIC GRAVITY.

17. What is your opinion of the value of this test?

18. What apparatus do you prefer, and what is the method of manipulation? (Please state any special precautions to be observed.)

STANDARD SAND.

19. What kind of sand should be used in tests of mortars? Would you

sistency has been obtained. It is hoped that this question will receive full and careful consideration.)

24. What should be the temperature of the materials used in mixing?

25. What should be the temperature of the air at mixing?

26. How should the quantity of water used in mixing be defined?

27. What should be the method of mixing?

28. Do you prefer hand or machine mixing? If the former, please describe manipulation in detail?

29. If the latter, what machine do you prefer, or what form would you suggest for trial?

30. Do you know of any machine that has given good results? If so, what is the method of manipulation, and what are its advantages and defects?

31. How long should the mixing be continued? Should this be defined by stating the length of time, or by reference to the character of

39. How shall the pats or briquettes be treated during setting?

40. What should be the temperature of the water in which pats are placed?

SOUNDNESS.

41. What do you consider the best test for soundness in the case of Portland cement? What in the case of natural cement? (Please describe in detail the process recommended and indicate any necessary precautions to be observed. If the process you prefer is too elaborate for any but a well-equipped laboratory, please indicate, if possible, any modifications for ordinary use, and give your opinion of the reliability of such simpler tests.)

TENSILE STRENGTH.

42. What proportions of cement and sand should be used in mortar for tests of tensile strength?

43. Do you advocate adhering to the American Society of Civil Engineer's form of briquette in future requirements? If not, what form do you prefer?

44. Is your preference based on comparative experiments, or is it the result of satisfactory experience with one form?

45. Upon what sort of a surface should the briquette be made?

46. Should the briquette be finished with a trowel on both sides?

47. What should be the consistency of the mortar? (See 23.)

48. What method of filling the molds do you advise? Do you recommend the use of a machine for molding, and if so, what form would you suggest?

49. Have you used the machine you suggest, and have the results been satisfactory?

50. How should the briquettes be treated during the first twenty-four hours after molding?

51. How should they be treated during the remaining time until tested?

52. If placed in water, how often should the water be renewed, and is it important that it should be maintained at a nearly constant temperature? What should that temperature be?

53. At what age should briquettes be broken for acceptance tests on ordinary work?

54. Under what conditions would you deem it essential to make longer time tests?

55. Will weighing briquettes before testing give information of value, and, if so, what?

56. What form of clip do you prefer?

57. What should be the distance between opposite gripping points of the same clip?



Controlling Works, Chicago Drainage Canal.

recommend a natural sand or crushed quartz?

20. What fineness should be specified, and what degree of variation in size of grain should be allowed?

PREPARATION OF PASTES AND MORTARS FOR TESTS OF TIME OF SETTING, SOUNDNESS AND STRENGTH.

21. Should the same method of preparation be used for each test?

22. How should proportions be stated?

23. What should be the consistency of the pastes and mortars for the various tests, and how may this consistency be specified and determined in order that similar results may be obtained by all operators? (This question is intended to embrace, not only the correspondent's view as to what consistency should be used, but also as to devices for determining when the proper con-

the resulting mortar?

TIME OF SETTING.

32. What do you consider the best method of determining the time of setting? (Please describe apparatus and manipulation.)

33. How shall the beginning of the set be defined?

34. How long shall the end of the set be defined?

35. Should this test be made on neat cement paste, or on mortars, and if the latter, what proportions of cement and sand should be used?

36. What should be the consistency of the mortar? (See 23.)

37. What should be the temperature of materials and of air, quantity of water, and method of mixing? (See 24, 25, 26, 27.)

38. What should be the method of making the pats, or of filling the molds, if they are used?

58. What should be the rate of applying the stress?

59. What style of testing machine do you prefer?

60. Can you suggest any desirable modifications to machines now in use?

61. What special precautions are necessary in breaking briquettes?

COMPRESSIVE STRENGTH.

62. Do you advise compressive tests, and, if so, why?

63. What form and dimensions of test piece do you prefer?

64. Should the test piece be treated differently as regards manipulation of mortar, mixing or setting, from tensile specimens? If so, please state in what particulars and why?

65. How should the specimen be prepared for the testing machine?

66. What form of testing machine do you recommend?

67. What should be the rate of applying the stress?

TRANSVERSE STRENGTH.

68. Do you advise bending tests? If so, under what conditions and why?

69. What form and dimensions of test piece do you prefer? What span?

70. Should the test piece be treated differently as regards manipulation of mortar, mixing and setting, from tensile specimens? If so, please state in what particulars and why?

71. What form of testing machine should be used?

72. What should be the rate of applying the load?

MISCELLANEOUS.

Under what conditions do you consider the tests indicated below necessary or desirable? What should be the manipulation for the test if used?

I.—Adhesion.

II.—Abrasion.

III.—Resistance to freezing.

IV.—Resistance to action of sea water.

GROUTING BY COMPRESSED AIR.

In the construction of the London Tower Subway, grouting was employed to fill the cavity left by the advance of the shield. This was accomplished by a hand syringe, the lime being mixed with water in a tub. The result was not satisfactory because the grout had to be sufficiently fluid to flow into the syringe and was too fluid for good work and the pressure that could be applied by the syringe was not sufficient to force it properly home into the spaces to be filled; moreover, this method of working could only be employed upon a very small scale. The author, some years later, devised the grouting ap-

paratus first used in the City and South London tunnels. A cylindrical vessel, capable of withstanding a pressure of seventy pounds or eighty pounds per square inch, has through its axis a shaft or spindle working in a stuffing-box at each end of the vessel, and provided at one or each end with a handle outside and carrying inside the vessel a number of paddles. The lime and water are introduced through an opening at the top having a lid capable of being closed air-tight; and the mixture is discharged by compressed air through a length of flexible hose-pipe ending in a branch and nozzle, the nozzle being inserted in holes in the tunnel lining provided for the purpose. The smaller grouting pans are usually worked by two men; one continually keeps the paddles revolving and opens and closes the air and discharge valves, while the other has charge of the branch at the end of the hose. As the space is gradually filled, the holes through which the grouting is discharged are successively closed. Beginning at the lowest hole, grout is forced in until it reaches the hole above it; the lower hole is then plugged and the nozzle applied to the higher, and so on until finally the highest hole in the key-piece is reached and the full pressure is brought upon the grout.

After experiments with Portland and Medina cements and blue lias lime the author came to the conclusion that the last was in some respects preferable; and, as it was much cheaper than the cements he adopted it for the City and South London Railway tunnels. Portland cement has, however, been used in some cases, and for special purposes Medina has been found to work well. The blue lias lime may be mixed with or without sand, and does not set hard suddenly like cement. It can be mixed with only so much water as it will retain in setting, it adheres to the surface of the iron firmly, and when fresh and used hot it expands in setting. No reliance being placed on the surrounding shell for strength, there is no object in having a shell harder than solid London clay.

THE ACTION OF SEA WATER UPON HYDRAULIC CEMENTS.

BY DR. WILHELM MICHAELIS.

(Translated and Abstracted by Walter Francis Reid.)

[From Proceedings of the Institution of Civil Engineers, England, Vol. CXXIX.]

When a saturated solution of lime acts upon the combined hydrates of silica, compounds of ferric oxide and alumina are formed, containing respectively 3, 4 and 5 molecules of lime to 2 of the oxides, and these

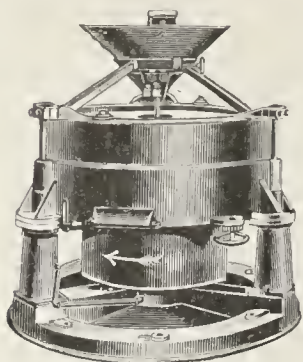
compounds are united with water in such proportion that at least 1 equivalent of water is combined with 1 equivalent of lime. Hydraulic cements rich in lime must, therefore, during the hardening process, segregate the lime as hydrate. In Portland cement the hardened mass is completely permeated with crystals of calcic hydrate. The hydrate of the combined aluminate and sulphate of lime



has been observed when the compound was dried over sulphuric acid, and the following calculations are based upon this proportion of water, although in practice it must be far greater. Each molecule of alumina present in hydraulic mortar as the hydro-alumina of lime can form about 12 parts of this double salt, and the hydro-ferrate of lime acts in the same way. The true Roman cements, containing 1 part by weight of silicate to 1.1 to 1.2 parts by weight of lime, are, from the chemical point of view, the best hydraulic mortars, because, during the hardening process, they form the most stable compounds, without unsaturated residues. Such cements are, however, burnt at so low a temperature that they are deficient in density, so that mortars made with them shrink considerably when exposed to the air through the evaporation of the water which they have absorbed. All water exceeding in quantity that required for the formation of calcic hydrate must be considered as water of expansion and is very loosely combined. Hydraulic lines, such as that of Teil, bear a close resemblance to Roman cements, but are even looser in texture. Of the 68.6 per cent of lime in Teil lime, 36.48 per cent only would combine with the other constituents during the setting process, leaving 32.12 per cent of lime in an uncombined state.

Portland cement, having been burnt at a higher temperature, is denser than Roman cement in the ratio of 5 to 3; but from the chemical point of view this cement is also defective, because, even supposing the richest calcareous compounds are produced during the setting process, there still remains an excess of uncombined lime. A Portland cement containing 61.04 per cent of lime would leave 13.79 per cent of lime unsaturated, while one containing 68.379 per cent would leave a similar residue of 29.1 per cent. In the case of a Portland cement of average composition, with 1 part of silicate to 2 parts of lime, 25 per cent of lime or 33 per cent of calcic hydrate would be segregated.

(To be continued.)



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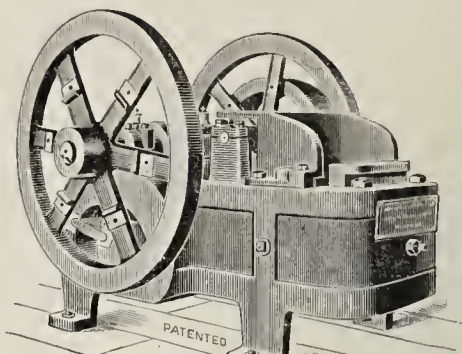
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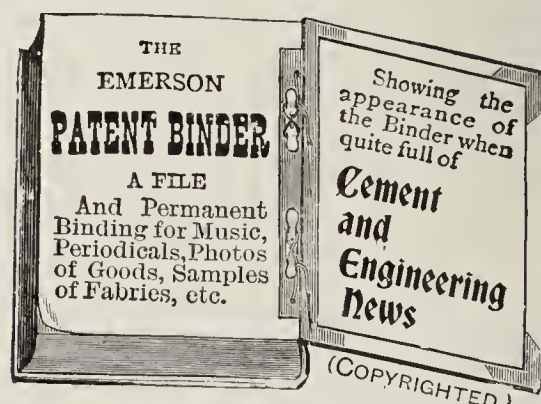
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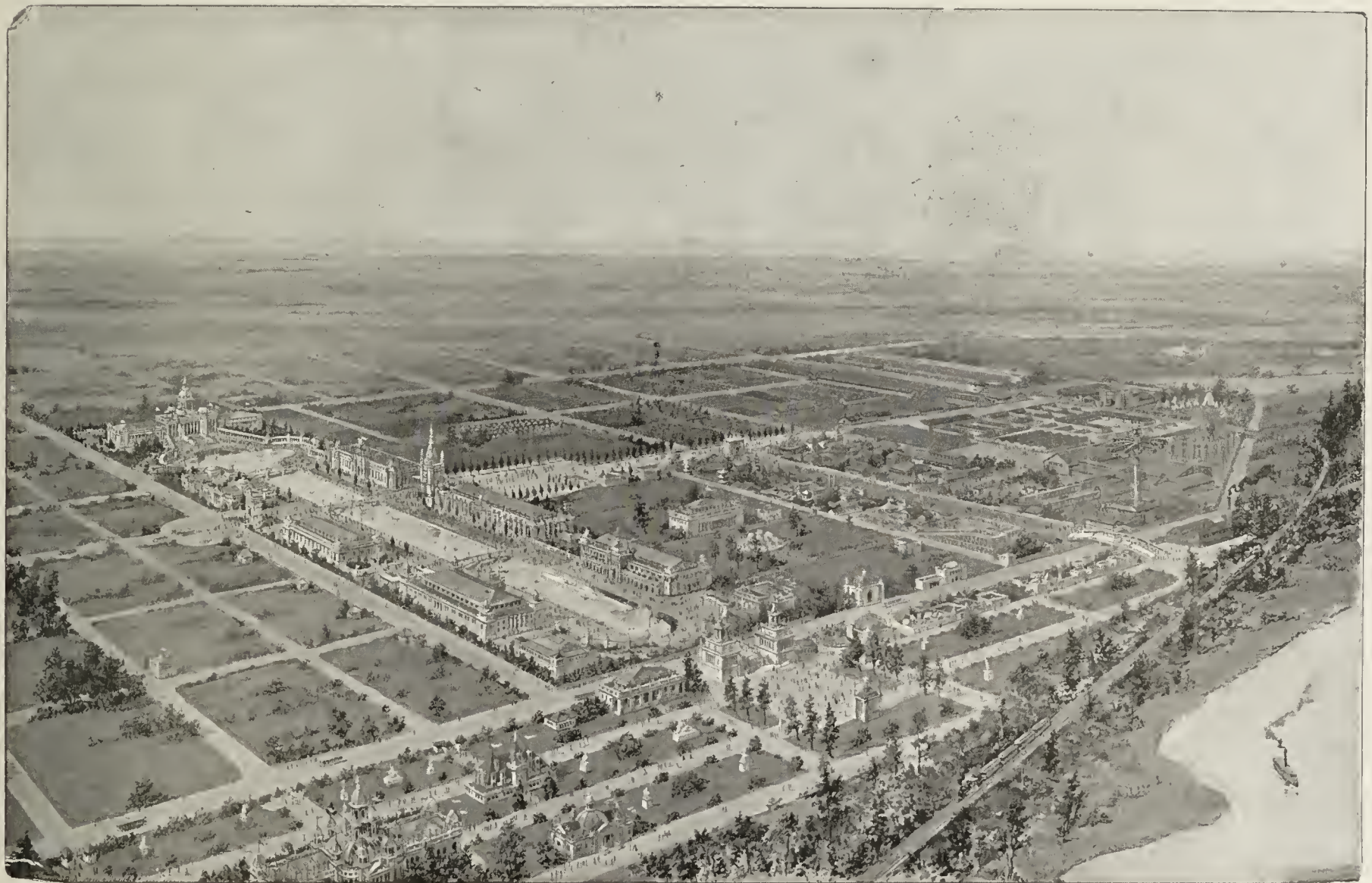
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OFFICIAL BIRD'S-EYE VIEW OF THE TRANS-MISSISSIPPI AND INTERNATIONAL EXPOSITION, OMAHA, NEB.

TRANS-MISSISSIPPI AND INTERNATIONAL EXPOSITION.

Two weeks before the date set for the opening of the Trans-Mississippi Exposition, a scene of great activity in all parts of the grounds is presented to the visitor. Workmen are putting down the final portions of wide walks around the lagoon, electricians are stringing wires and putting in innumerable incandescent lamps all over the grounds, the carpenters are still at work on a number of the smaller state buildings, on many of the midway amusement places, and in a few cases on structures of minor importance in the main portion of the grounds. It is a very noticeable fact, however, that the big palaces in which the thousands of exhibitors will display

duced during the summer and fall by the massive buildings, set off with just a sufficient dash of color to relieve the monotony, all facing the waters of the lagoon.

At the west end of this large stretch of water is the government building, by reason of its commanding position, the most imposing of all. On the north side are the agricultural hall, the administration arch, the manufacturers building, with an immense annex in the rear, the electricity building and machinery hall, and the boys' and girls' building not yet entirely completed. On the south side of the lagoon the art palace has the place of honor on the right hand side of the United States government building. The arch of states at the main entrance towers up

buildings; to the north the midway. Nebraska and Illinois, completed but for a few final touches, stand out conspicuously among the sister states. Nebraska has adopted a very light terra cotta tint for the walls, and greens and blues have been made use of in decorating the cupolas and other features of the roof. The Illinois building is made distinctive by a pretty shade of red on the main portion of the roof. A number of other state buildings, in more or less advanced stages of completion, are scattered over this section. The whole of the bluff tract is parked in a most attractive manner, and the section devoted to the state buildings is separated from an acre or two of green grass and trees and flowers and gravel walks by the large horti-



NEBRASKA STATE BUILDING.

their wares are all ready for the installation of exhibits. In many cases the booths or stalls for the exhibits are already constructed or under construction. In a few cases the entire exhibit is in place. The main buildings are deserted on the outside, but on the inside large forces of men are working with a zest which indicates the determination of the exhibitors by whom they are employed to have their individual portions of the great whole ready for the visitors when the gates are thrown open on the morning of June 1.

Amid the general buzz of activity, the impression created on the visitor at present is that a great undertaking is in the last stages of completion. It requires little or no assistance from the imagination to realize the enchanting effect that will be pro-

duced above all the surrounding structures, but is not yet up to its highest point. Much of the staff work on this edifice is yet to be attached, but there is plenty of time yet for this to be completed before the opening day. East of the big archway are the liberal arts building, the mines and mining building, and the auditorium. The picture of glittering lagoon, crossed by one iron bridge in the center, bordered by a slightly sloping bank of grass, and in a frame of nearly a dozen massive white buildings all connected by colonnades, as seen from the viaduct at the east end of the basin, is one not soon to be forgotten.

Across this viaduct, itself a notable instance of the skill displayed in the laying out of the grounds, is the bluff tract. To the south are the state

cultural building, which is thus set in a most appropriate spot.

The midway, on both sides of Sherman avenue, occupying the ground to the north of the main portions, is rapidly taking shape. Most of the leading attractions of the World's Fair are already housed and many new features are being provided. The tower for the giant see-saw, which will take the place of the Eiffel Tower at London and the Ferris wheel at Chicago, is almost completed. The streets of Cairo, the Morrish and German villages, Hagenbeck's wild animal show occupy conspicuous places.

North and west of the midway are the transportation building and the ground set apart for the irrigation and live stock exhibits, sugar beet fields, etc. This is the only portion

of the grounds which will undergo much of a transforation between now and the opening day.

Taking the display as a whole there is nothing to which comparison is invited, save the World's Fair. Members of the United States government commission and of the Illinois commission pronounce the general plan and architecture of the Trans-Mississippi Exposition to be superior in artistic effects to any American exposition, and is well worthy of the patronage of the people of the United States.

The F. J. Clarke Company, lime, cement and stone have been incorporated with a capital of \$5,000. Office, Mamaroneck, Westchester county, N. Y.

aluminate and finally the silicate. The formation of the sulphate with two equivalents of water causes a considerable increase of volume and may destroy the cohesion of the mass. With this formation of gypsum the production of lime aluminate-sulphate goes hand-in-hand, and this causes an enormous increase of volume, and a total destruction of the cohesion, for this double compound crystallizes with at least thirty, probably sixty, equivalents of water, and in doing so converts the strongest mortar into a mud, the only parts of which retaining any cohesion being those protected by the formation of carbonate. Good Roman cements resist the action of sea-water well because they only contain enough sulphate of lime to form sixteen parts of the double salt which finds sufficient space for

In order to ascertain the action of carbonic acid and sea-water upon the strength of Portland cement, a series of experiments were carried out. Two sets of briquettes were made according to the German standard rules, one composed of one part by weight of Portland cement to three parts by weight of standard sand, and the other of one part cement to five parts of standard sand. These briquettes were allowed to harden for twenty-four hours in the air, but protected from carbonic acid, and were then placed in boiled distilled water for fifty-six days, the vessel in which they were kept being hermetically closed. Half of the briquettes were then treated with moist carbonic acid for five weeks, and were finally returned to the closed vessels, in which they remained four weeks



AUDITORIUM BUILDING.

THE ACTION OF SEA WATER UPON HYDRAULIC CEMENTS.

By DR. WILHELM MICHAELIS.

(Translated and Abstracted by Walter Francis Reid.)
[From Proceedings of the Institution of Civil Engineers, England, Vol. CXXIX.]

(Continued from page 61.)

A body containing a substance of such strong chemical affinity as free lime cannot be regarded as stable. The free lime will continue to react until it forms a saturated compound. When the mortar hardens in the air or in water containing carbonic acid, the lime is converted into carbonate; but in sea water it is chiefly the sulphates which act upon the lime. In the first instance it is the free lime that is converted into carbonate or sulphate, then the very unstable compound with ferric oxide, then the

expansion in the pores of the mortar. In such hydraulic limes as that of Teil there is little alumina, and consequently the chief increase of volume is due to the formation of calcic sulphate and not to the double salt. One of the reasons why Teil hydraulic lime has proved more successful for marine work than Portland cement is that the blocks made with it are allowed to harden in the air for a long time before immersion, while Portland cement is generally exposed to the action of sea-water at once. Even if Portland cement concrete blocks be exposed to the air until a protective skin of carbonate of lime is formed, such a skin cannot attain any considerable thickness, and the chemical reactions to which the destruction of the cohesion must be attributed will eventually take place.

longer. When tested, the briquettes were therefore 120 days old. The 1:3 mortar protected from carbonic acid gave a tensile strength of 26.9 kilos per square centimeter, while the briquettes treated with that gas gave 28.5 kilograms per square centimeter (405.3 lbs. per sq. in.) The crushing strength was 309 kilograms per sq. centimeter in the first case and 338 kilograms per sq. centimeter (4,806.3 lbs. per sq. in.) in the second. The 1:5 mortar protected from carbonic acid broke at a tensile strain of 14 kilograms per square centimeter (199 lbs. per sq. in.) and, treated with carbonic acid, the strength increased to 16.8 kilograms per square centimeter (238.9 lbs. per sq. in.) The crushing tests gave 112 and 138 kilograms per square centimeter (1,592.6 and 1,962 lbs. per sq. in.) respectively.

In the 1:3 briquettes only 13.3 per cent of the total lime, and in the 1:5 only 24.8 per cent was converted into carbonate. These briquettes being very small and the conditions for the absorption of carbonic acid favorable, it is evident that even a long exposure of concrete blocks to the air would only cause a very thin film of carbonate to be formed. The whole of the lime was not converted into carbonate until the mortar had been coarsely powdered and exposed to the action of carbonic acid for some time. Immersed in sea-water, or in a 2 per cent solution of magnesium sulphate, the briquettes which had been protected from carbonic acid soon disintegrated, and even those which had been carbonated were strongly attacked in seven months, especially the 1:5 mortar, although this had absorbed more carbonic acid.

In fresh water the conditions are more favorable, for only the free lime can be dissolved or converted into carbonate. The more lime is dissolved out the more insoluble are the residual silicates and aluminates. The whole of the lime can never pass into solution, although this may be effected on a small scale when carbonic acid is excluded. A well mixed and burnt Portland cement may contain 70 per cent of lime and yet resist the action of fresh water.

The magnesia which is deposited during the action of sea-water upon hydraulic mortar is a preservative agent which tends to close the pores of the mass. It would be more correct to speak of the injurious action of the sulphates in sea-water than to attribute such action to the magnesia salts, although it is true that magnesium sulphate is the special salt which acts in sea-water. The sulphates of lime or of the alkalis, in fact, any soluble sulphate, have the same destructive action; but do not act with the same degree of energy.

The author finds as the result of his investigations that those cements which are richest in lime are those which offer the least resistance to sea-water. The addition of lime or of more calcareous cements to Portland cement mortar is therefore unsuitable, and modern Portland cements of high strength, but rich in lime, are less suitable for marine work than the older cements containing less lime. A mortar containing free caustic lime is as unstable from a physical as from a chemical point of view. By the reaction already explained, great internal strains are produced and expansion and cracking continue, sometimes for many years. All these defects may be avoided by offering to the lime which remains or becomes free during the hardening process, hydraulic silica or

alumina with which it can form more stable compounds. The disadvantage of the efflorescence of caustic alkali cannot be avoided; but as the quantity is small, and it is easily soluble, this caustic alkali cannot endanger the stability of the mortar. In water the alkali is simply washed out; in the air it is only a temporary efflorescence which cannot be washed off.

The addition of milk of lime to Portland cement mortars must be injurious and hastens their destruction. Even in fresh water the advantages of such an addition are only apparent; the excess of lime is easily washed out and the mortar soon becomes porous. Even in two or three years a diminution in the strength of such cement-lime mortars takes place. The action of carbonic acid may come to the rescue, but the chief use of this addition is to make poor mortars more plastic.

In carrying out experiments on the action of sea-water upon cements, it is of importance that the test-pieces should be as porous as possible, otherwise the results would only be delayed. In carrying out a series of experiments with various mortars the author used artificial sea-water, and solutions of calcium sulphate, magnesium sulphate and sodium sulphate. The mortars were moulded in the form of prisms ten centimeters long with a rectangular section of five cubic centimeters. For twenty-four hours the briquettes were allowed to harden in moist air, from which carbonic acid was excluded; they were then placed in the test solutions. The solutions were renewed daily for fourteen days, weekly for three months, and then monthly. One of the mixtures which withstood the action of calcium sulphate best was Teil lime mixed with five parts of standard sand; but all mixtures containing hydraulic silica either as hydrate, or in the form of trass or burnt kaolin, were but slightly acted upon, and remained intact after the lapse of two years.

In a one per cent magnesium sulphate solution similar results were obtained. Neat Portland-cement mixtures, without the addition of hydraulic substances, soon disintegrated, especially in the case of those cements rich in alumina. A Bavarian Roman cement containing 47.2 per cent of lime stood well, while a Bosnian Roman cement with 49 per cent of that substance began to show signs of deterioration. Long before there are visible signs of disintegration through the action of sea-water the tensile strength indicates whether an injurious action is taking place. As porous briquettes are more rapidly acted upon than impervious ones, it is advisable to use a mortar containing one part of cement to five parts of sand, rather than one composed of the 1:3 mixture. A number of experiments were carried out by the author, in which the briquettes were composed of one part of cement mixed with five parts by weight of Berlin standard sand.

THE END.

MARL LAND FOR SALE.

A fine body of first-class marl land suitable for the manufacture of a high grade Portland cement. This tract contains 200 acres, showing an average depth of 12 feet. On water transportation—reaching all points on the great lakes direct, with an abundance of suitable clay which may be dug from pits of dredged from submerged lands from three to five feet below the water surface. An abundance of cheap fuel; 12 feet of water at the docks now on premises. This marl deposit has been thoroughly tested and shows 96 per cent. of carbonite of lime. An excellent opportunity for a large plant. For information, address WATER TRANSPORTATION, care CEMENT AND ENGINEERING NEWS, Chicago.

An advertisement in CEMENT AND ENGINEERING NEWS brings reward.

IMPORTS OF CEMENT INTO THE UNITED STATES.

WHERE FROM.	MARCH.				NINE MONTHS ENDING MARCH.			
	1897.		1898.		1897.		1898.	
	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.
United Kingdom....	6,062,445	20,738	2,472,672	9,004	149,264,813	486,438	105,716,089	352,763
Belgium.....	21,514,227	59,542	10,303,242	46,295	194,663,934	564,863	172,406,279	521,365
France.....	352,727	1,482	446,400	1,539	9,256,688	26,194	11,710,916	33,888
Germany.....	17,211,196	54,742	29,539,243	98,632	301,553,146	992,341	298,216,225	1,002,464
All Other Europe...			4,472,990	12,360	7,714,647	28,825	16,549,381	50,497
British North Am....					2,094,900	8,368	1,304,249	6,207
Other Countries.....					802,011	3,872		
TOTAL.....	45,140,595	136,504	53,234,547	167,830	665,350,139	2,110,901	605,908,139	1,967,184
Domestic Exports of Cements, bbls.	5,284	9,378	4,589	8,582	26,172	48,355	38,412	66,498

There were 5,258,185 lbs. of imported Roman and Portland cements, etc., in the United States bonded warehouses on March 31, 1898, valued at \$15,406, against 9,056,971 lbs., valued at \$25,872, in March, 1897.

Imports of asphaltum or bitumen for March, 1897, were 6,091 tons valued at \$27,883; March, 1898—3,044 tons valued at \$10,361. For nine months ending March, 1898, 68,440 tons valued at \$229,620; for nine months ending March, 1897—68,859 tons valued at \$221,653.

CEMENT AND ENGINEERING NEWS.

(PUBLISHED MONTHLY)

WILLIAM SEAFERT, Editor and Publisher.

OFFICE—161 LA SALLE STREET.

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FOREIGN SUBSCRIPTION - - -	2.50 " "

ADVERTISING RATES SENT ON APPLICATION.

"This world belongs to the energetic."

Chicago, May, 1898.

CORRESPONDENCE.

We solicit correspondence on all matters of general interest to the cement trade in all of its branches. Engineering notes, public improvements, and facts and opinions drawn from practical experience will be welcome.

THE INDUSTRIAL CAPACITY OF THE SPANISH NATION.

For more than a century Spain has slept on her natural resources, wasting and consuming her energies in internal broils and revolutions, fomented by cliques in the army and navy to advance personal interests in violation of sworn allegiance. This inborn capacity for intrigue has diverted attention from promoting and encouraging the mechanical arts on the part of the reigning authority, courting instead the good will of the army and navy, by installing favorites in positions of honor and trust at home and abroad, especially in the colonies, where, intrenched with supreme authority, the natives can be oppressed and robbed, under the forms of law, in the direct interest of the military officials. Instead of developing her natural resources by stimulating manufacturing enterprise the Castilian looks down upon the mechanical arts, preferring to be dependent upon other nations for her ships and munitions of war. After expending millions for a navy she seems to possess neither skill or tact to use it with efficiency.

The modern battleship is simply a fighting machine calling for the highest degree of engineering and mechanical skill to render it effective. In this Spain is sadly deficient. In this age of steel Spain has failed to

grasp the situation. With all the resources of modern science at her door to assist in developing her natural resources she has not placed herself in position to profit by the opportunity, while her vast deposits of iron ore form the base of supplies of the English, French and German iron masters. This dry rot in her industrial capacity leaves her dependent upon England, Germany and France for war supplies and even these are now sealed against her under proclamations of neutrality. With a debased credit abroad and a mere reproductive capacity for munitions of war at home, Spain presents a spectacle of a nation saturated with false pride, corrupt officials and misdirected energies, all tending to restrain manufacturing enterprise.

CONCRETE AND BETON.

A distinction is sometimes made between the English word "concrete" and the French word *beton*. In France it is customary to mix the lime or cement with the sand and water, and thus to form mortar; the broken stones or other materials are then added to the mortar, and thoroughly mixed with it. In England, however, the general practice is to mix the whole of the ingredients dry, and, when the mixing is sufficiently advanced, to add water gradually, the ingredients being still further turned over during the operation.

Some writers limit the meaning of the word concrete, by applying it only to concrete prepared in the English way; and the word *beton* is taken to mean concrete prepared in the French way. There does not seem much reason, however, in thus limiting the meaning of the word, for concrete is concrete, no matter how it is prepared, just as stone is stone whether it be formed by the aggregation of countless myriads of microscopic organisms, or merely by the consolidation of sand-grains. We shall use the word concrete in its wider sense, especially as this is the sense in which it is now generally used.

Captain W. W. Rich, late chief engineer of the Sault Ste. Marie railway has been appointed consulting engineer to the Chinese railway administration, with headquarters at Shanghai.

SOME OF THE GREAT ARTIFICIAL WATERWAYS.

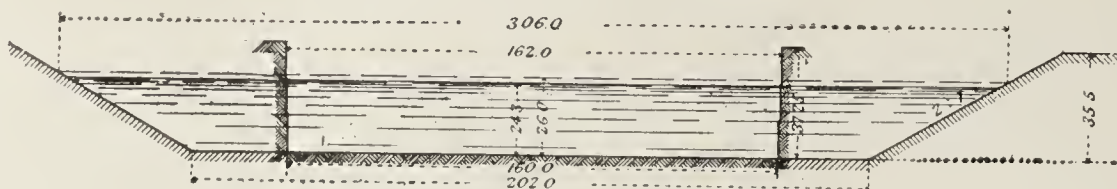
The recent agitation of the project of establishing a deep waterway between Chicago and the Atlantic seaboard has again brought up for consideration some of the many remarkable feats of hydraulic engineering that have from time to time engaged the attention of the world in their newness. Having demonstrated their usefulness they have passed to their places in the economy of the industrial world and have been largely forgotten, except at times when projects of similar nature, and perhaps greater conception arise for consideration. A contemporary, treating of these matters, has assembled the following statistics relative to waterways that have figured prominently in the advancement of civilization.

The Chenab irrigation canal, in the northwest provinces, India, is 200 feet broad. It is doubtless the largest canal in the world. Its main channel is 450 miles long, while the principal branches have an aggregate length of 2,000 miles and the village branches will extend, when completed, for an additional 4,000 miles. Apart from irrigation, the longest canal in the world is that which extends from the frontier of China to St. Petersburg, and is 4,472 miles in length. Another Russian canal, from Astrachan to St. Petersburg, is 1,434 miles long; both the last named canals were begun by Peter the Great. The Bengal canal, connecting with the River Ganges, completed in 1854, is 900 miles in length and cost £2,000,000 sterling, or £2,200 per mile. The total length of canals in India for irrigating 8,000,000 acres is calculated at 14,000 miles. The Canal du Midi, connecting the Atlantic with the Mediterranean, is 148 miles long. The Caledonian canal in Scotland has a length of 60 miles. The Ohio canal is 332 miles long.

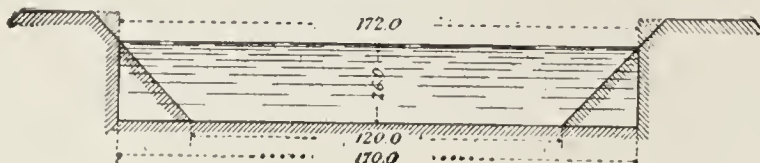
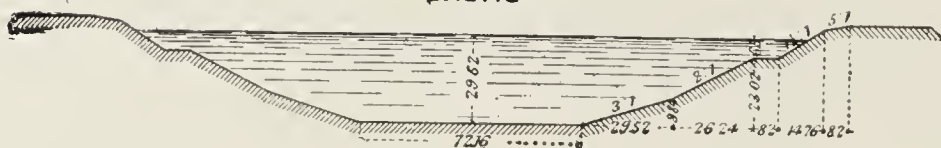
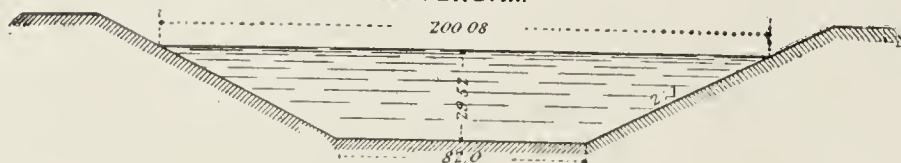
Six thousand barrels Natural will be used by the government at Fort Jackson, 71 miles below New Orleans in fortification work at that point.

The government has awarded the National Building Supply company of Baltimore, Md., a contract for 15,000 barrels of Portland cement for the new fortifications at Bolivar Point, the Denver resurvey and the rapid-fire battery at Fort Point at Galveston, Texas; also, the contract for 1,000 barrels of Portland cement for North Point, near Baltimore, and 12,000 barrels for Fort St. Philip, near New Orleans, La. The contracts call for delivery within thirty days.

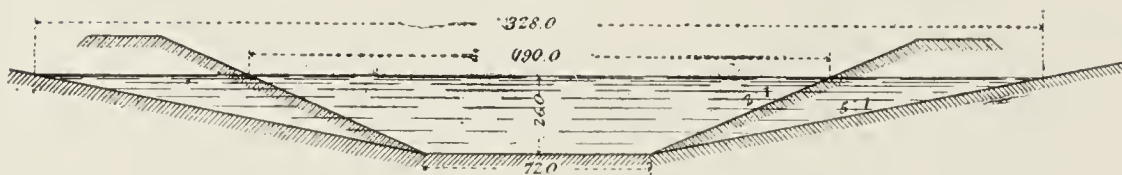
SANITARY CANAL - CHICAGO



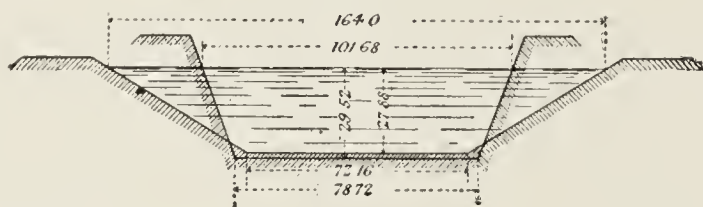
MANCHESTER

NORTH SEA
- BALTIC -NORTH SEA
- AMSTERDAM -

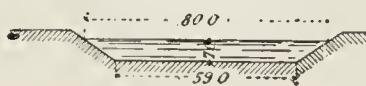
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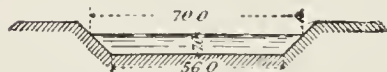
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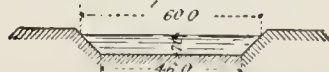
WELLAND

ILLINOIS & MISSISSIPPI
HENNEPIN -

ERIE



ILLINOIS & MICHIGAN



LENGTH AND AMOUNT OF EXCAVATION OF NOTED CANALS.

- Baltic Canal.—Length $61\frac{2}{3}$ miles; excavation 104,640,000 cubic yards.
 Manchester Canal.—Length $35\frac{1}{2}$ miles; excavation 50,000,000 cubic yards.
 Suez Canal.—Length 170 miles; excavation 80,000,000 cubic yards.
 Nicaragua Canal.—Length from 172 to 194 miles.
 Panama Canal.—Length $45\frac{2}{3}$ miles; excavation 130,778,000 cubic yards.
 Amsterdam Canal.—Length $17\frac{1}{2}$ miles. excavation 30,261,602 cubic yards.
 Illinois and Michigan Canal.—Length $97\frac{1}{4}$ miles.
 Welland Canal.—Length $26\frac{3}{4}$ miles.
 Erie Canal.—Length 363 miles.
 Hennepin Canal.—Length 77 miles; excavation 9,084,164 cubic yards.

TULLOCH & CO.'S MONTHLY REPORT

The demand for domestic consumption and export continues exceedingly active. In fact, the trade generally has now reached a position in which the works are unable to supply the current demand.

This applies equally to the trade in Great Britain, in Germany and in Belgium. In many directions building and engineering work is impeded owing to the absence of supplies of cement, and for delivery representing quite an advance of 2s. to 2s. 6d. per ton on rates paid during March and April.

All the mills situated on the Thames and Medway report that present demand is a record one in the trade. Although each mill is running continuously the works are weekly refusing orders to the extent of thousands of tons, being quite unable to promise any given date for delivery. One result of the oversold condition of the London mills is a large demand from British consumers for German and Belgian cements amounting to quite 100,000 to 120,000 tons. It must be remembered that, hitherto, it has been a rare occurrence for any continental cement to find a market in this country, and every ton of cement sold to Great Britain by German and Belgian makers means so much less available for export to other foreign markets.

Whilst the total quantity is not large, it has the effect of further advancing prices on the continent, and if the present cement famine in this country continues it is probable that consumers here will be prepared to pay even higher prices for continental cements, and thus attract further supplies to this country from manufacturers in Germany and Belgium.

In Germany the inland consumption is even now more active, and nearly all the mills in Central and South Germany are refusing business, as they cannot promise any further deliveries for the next four or five months.

In North Germany, where the production of cement is large, there is perhaps less difficulty in obtaining delivery, but those works favorably situated for export business have more orders than they can currently deliver and are able to obtain their own prices.

With the object of checking up position our representative has recently made a trip through Germany and Belgium, and we are able to thoroughly endorse the all-round record activity of demand, and state confidently that prospects point to no diminution in demand during the next twelve months.

Benjamin Franklin says: "Men like to become acquainted before they begin to trade with each other." Advertising does it.

The Cassadaga Portland Cement company of Cassadaga, N. Y., has now more orders for cement than it can furnish in 1898.

At the present time, the bulk of the works in Germany are behind-hand in their contracts with their various customers, and it is needless to say that owing to the big advance in prices obtainable for local consumption most of the domestic buyers are calling for the maximum quantities they are entitled to under their contracts.

Everything points at present to a further advance in price and we should not be surprised before the end of the year to find Ms. 7. freely paid for export.

With regard to Belgium, the demand for cement shows no diminution and most of the works are unable to quote with current orders. The more noted artificial cement works, such as Norths, Duffoses, etc., have not a barrel to sell outside of their regular contracts, and it is probable that as the year goes on scarcity of supply will become accentuated.

As regards the Natural Belgian cement works, their current production is more than sold, and high prices are being paid for prompt delivery. As against an average price of 4s 6d current earlier in the year for a first-class quality natural cement today's current value is 5s, and we believe rates will further advance. Naturally, this big demand for cement has incited many firms to endeavor to offer inferior qualities at attractive prices, but these offers are treated with suspicion by those buyers who are accustomed to the Belgian trade.

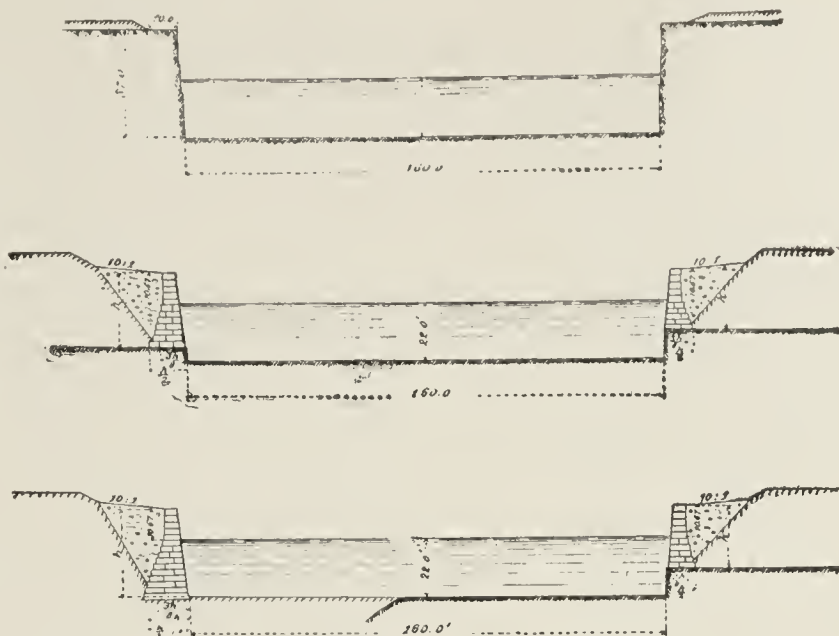
Taking the position all round, it may be safely said that we are now in the middle of a record season of activity and prosperity. The most embarrassing feature is the inability of the cement trade to supply current requirements, and it is unlikely that this year will see any extensive increase in production. In time, no doubt, should the present boom continue, various mills will succeed in increasing their production, and thus gradually supply will be equal, and in time no doubt exceed the current demand. As we stand now prospects point to this condition being somewhat a distant one.

We strongly recommend our various friends to endeavor to cover themselves for their requirements for the next few months, and repeat our assurance to give every possible information and assistance in regard to any purchases they may wish to make.

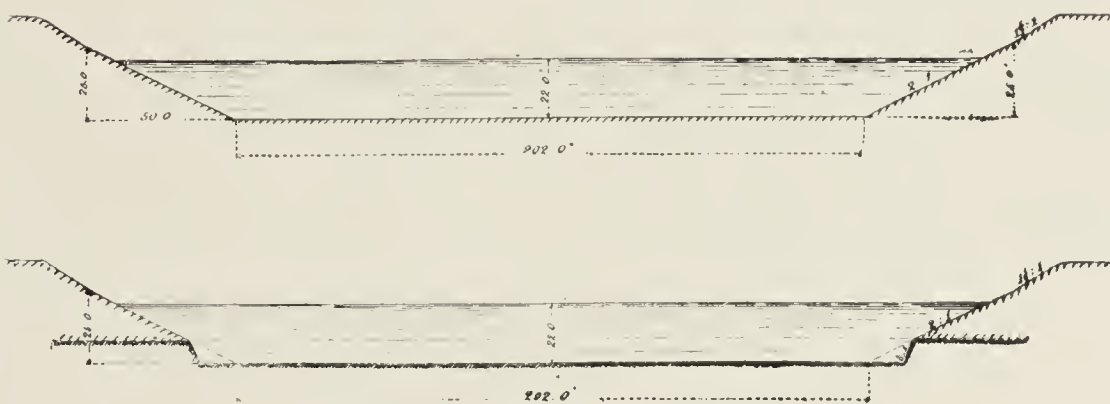
TILLOCH & Co.,
Importers and exporters of cement.
4 Fenchurch avenue, London, Eng.,
May, 1898.

Advertising creates a demand for the article advertised. Catch on?

Cross Sections — OF THE — Channel in Rock.



Cross Sections — OF THE — Channel in Earth.



CHICAGO DRAINAGE CANAL.

About Twenty-Nine Miles Long; 41,344,271 Cubic Yards of Excavation.

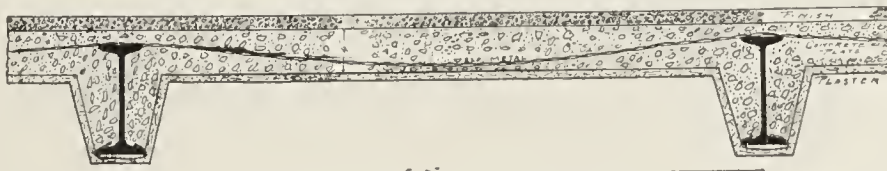
CONCRETE FLOORS IN SUGAR REFINERY.

One of the most conspicuous objects on the Brooklyn water front is the great plant of the New York Sugar Refinery company now nearing completion.

The entire floor area of 200,000 square feet will be of concrete and expanded metal carried on 12-inch steel beams with spans between

tions of the building where extra heavy loads are to be imposed, two sheets of expanded metal were used.

Within sixty days after completion of the first floor a scientific test was made by the use of a hydraulic machine, applying pressure on one square foot midway between beams, 4-feet span, with the result that the floor, without cap finish, but containing double thickness of expanded metal, stood 40,000 pounds without



Concrete and Expanded Metal Floor.

beams ranging from 3½ to 5 feet, on which was laid a concrete floor in blanket form 3½ to 4 inches thick, made according to the usual formula of Atlas cement, sand and cinders, in proportions of 1, 2 and 5 finished with a granolithic top fill 1½ inch thick. The expanded metal as shown in accompanying cut was laid in the lower part of the concrete, forming the tension of the flat arch. In por-

deflection or crack. Another section with a span of 4 feet 10 inches, with cap finish and one thickness of expanded metal, stood a pressure of 37,000 pounds, with a deflection of only ⅓ of an inch.

The accompanying cut shows the details of floor construction employed in this great factory. Messrs. Doe-scher & Sons, Contractors, and Louis Engel, Engineer.

CONCRETE RESISTANCE TO FIRE.

The resistance of concrete to fire varies greatly according to its composition. Portland cement is the best matrix, and coke-breeze, brick, and slag are among the best aggregates, in this respect. * * *

The actual amount of heat conveyed to iron bars through 2, 3, and 4 inches of concrete, has been ascertained by Mr. Thaddeus Hyatt. The thermal diagram shows the results obtained by him, and is a modification of the one given in his book on concrete. A furnace, about 18 inches wide internally, was constructed, its top being formed of concrete. The width of the concrete over the fire-box of the furnace, was divided into three parts, each part having an iron bar let into its upper surface; the right hand bar was protected under-

the 3 inches thickness of concrete is higher than a mean between the 2 inch and 4 inch thicknesses, which may be accounted for on the ground of its position at the center of the top of the furnace."

The diagram shows "that in three hours after the fire was lighted, the temperature of iron protected by 2 inches of concrete was 250°; in five hours, it was 650°, and, finally, at the end of 12 hours 900°, or red hot in the dark; while the iron protected by 4 inches of concrete for five hours and a half did not exceed 212°; in eight hours and a half the temperature was 450°, and at the end of 12 hours, 550°, or less than the melting point of lead."

We are not told whether the concrete remained perfect at the end of the experiment, or not, but we presume that it did, otherwise Mr.

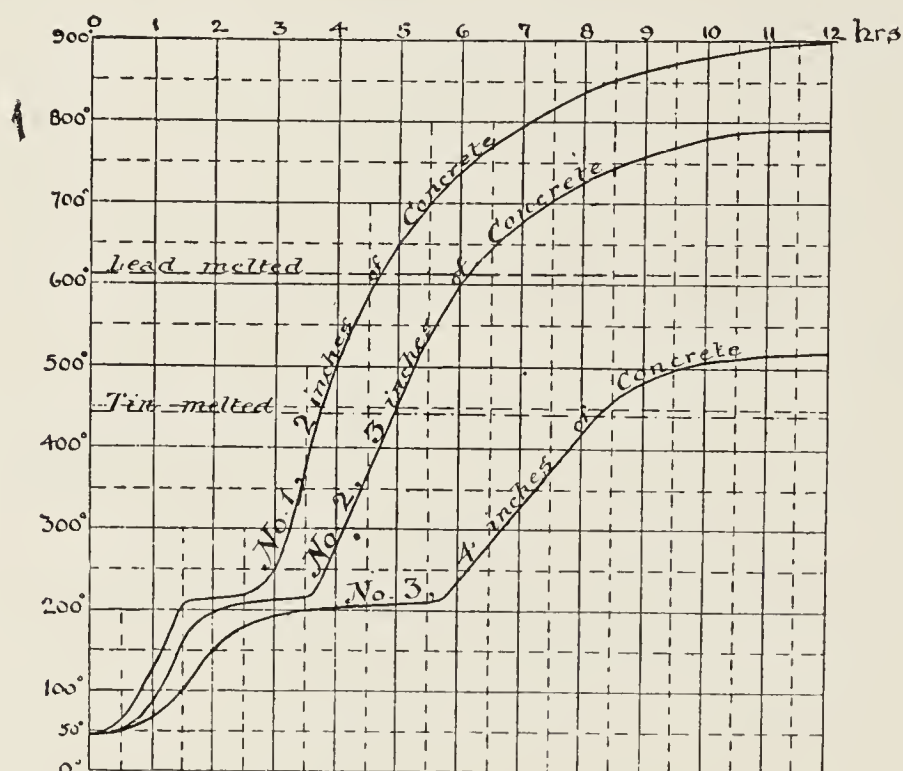
over the entire surface, and the bottom of the concrete was also at a glowing red heat all over. At this insensibility the fire was kept up until 4 p.m., a period of ten hours from the lighting of it. During this time the slab had deflected $\frac{3}{8}$ of an inch. A stream of cold water was now thrown forcibly against the bottom of the slab for a period of 15 or 20 minutes, by means of a garden force-pump, and the load then removed. On examining the underside of the section it was uninjured; and the next morning, being then entirely cold, the deflection had disappeared, the slab having returned to its former level. In order to confirm these results, a second trial was made; this time the load was left upon the slab, which during the firing deflected as before, but upon cooling returned to its original level, *lifting the load with it*. In proof of the heat of the furnace it may be mentioned that in the course of this experiment the faces of all the side bricks in actual contact with the fire were melted."

These experiments seem to show that good concrete will resist fire to a very considerable extent, and that a thickness of 2 or 3 inches will effectually prevent iron from being damaged in (at least) moderately severe conflagrations. And it must not be forgotten that in those buildings where the goods, etc., are not particularly inflammable and numerous, a floor, which will resist fire for a few minutes only, is frequently the means of confining the fire until extinguishing appliances can be brought into use, and in this way of preventing the destruction of the premises. An ordinary wooden floor, on the other hand adds fuel to the flames, and assists in the work of ruin.—"Concrete; Its Nature and Use," by G. S. Sutcliffe.

NEW CAPITOL BUILDING FOR MEXICO.

A new capitol building for the Mexican government, costing \$5,000,000 in Mexican money, is to be erected in the City of Mexico. The building will be 330 feet square and surmounted by a large dome of imposing design, supported by thirty-two columns. Competition for the award of the design was opened about a year ago and closed last November, fifty-two competitors from all parts of Europe and United States taking part. The first prize of \$15,000 has been awarded to Adamo Boari, a Chicago architect and native of Italy, who did considerable work in the designing of the World's Fair buildings previous to 1893.

Cement and Engineering News \$2 per annum.



neath by 2 inches of concrete, the middle one by 3 inches, and the left-hand one by 4 inches. The composition of the concrete is not definitely stated, but it was presumable the same as in some other experiments, namely, 1 part Portland cement and 2 parts crushed stock bricks. The age of the concrete also is not stated. The fire in the furnace was kept burning for 12 hours, "an intense heat being maintained the whole time, and the temperature noted every few minutes."

"It will be observed on examining the chart that the thermal lines, as they approach the boiling point of water remain in that vicinity for some considerable time, the explanation of which is that this length of time was required for the evaporation of certain amount of free moisture contained in the concrete, after which the temperature again continued to rise as before. It will be also noted that the thermal line of

Hyatt would have noted the damage. Apparently, however, he wished to make assurance doubly sure, for a second furnace was built 5 feet long and 2 feet wide internally, the top being formed with a slab of concrete (presumably of 1 cement to 2 crushed brick) which had a bearing of 6 inches at each end of the furnace but was quite free at the sides. In the middle of the concrete wrought iron was imbedded in gridiron form, "3 inches of concrete being above, and 3 inches below the metal. Loose bricks were piled upon the furnace top until a load was obtained of 300 pounds to the foot square over the whole surface, the deflection being with this load $\frac{1}{32}$ of an inch in a span of 5 feet. The fuel was arranged to form an incandescent bed 6 inches thick at 12 inches below the under face of the concrete slab. The fire being kindled at six o'clock in the morning, had by eleven become an intense heat perfectly uniform

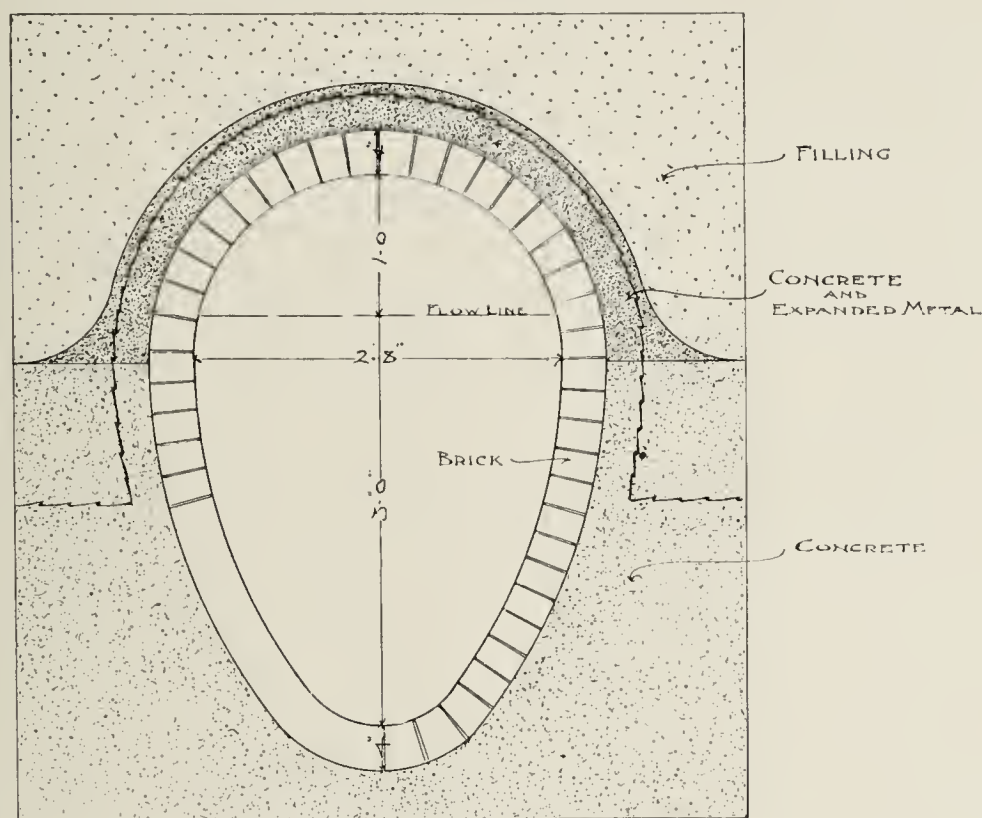
EXPANDED METAL IN SEWER BUILDING.

The utility of expanded metal as a strengthening cord in concrete construction is of wide application. A very desirable use for it was developed somewhat recently in Boston. Some two years ago a difficulty was met with in the building of a large sewer in the Neponset Valley, at a location where it was not possible to secure sufficient room for filling on top of sewer, without going above grade line, to keep the sewer from bursting out at the top. The section of the sewer in question ran through private property, and the owner would not permit extra filling to weigh down the ordinary sewer construction. The engineer of the Metropolitan Sewage Commission, after examining the merits of expand-

The accompanying illustration shows clearly the method employed in using the expanded metal to reinforce the concrete. In all something over 10,000 square feet of expanded metal was used in this work.

AN ENGLISH STABLE FLOOR.

We illustrated a plan of a stable floor, showing the diagonal V-shaped groove in the stall at AA, passing into the larger V-shaped or semi-circular channel at B, which in turn leads into the main channel at C. The last may be formed to receive an iron grate, or may consist of a stoneware or iron gutter bedded in the concrete. A raised footway is provided at DD, which may be grooved to almost any pattern, although it must be remembered that



Concrete and Expanded Metal Sewer Construction, Boston, Mass.

ed metal concrete floors, was induced to make a trial in the re-inforcement of concrete with this material. The measure of satisfaction in the test is shown by the following extract from a letter he addressed to the Eastern Expanded Metal Co. a few weeks ago:

"Gentlemen: Accompanying this please find blue print showing a section of sewer with arch reinforced by the use of concrete in which has been imbedded expanded metal. There were about 500 running feet of this sewer treated as shown, with very favorable results. The metal was easily handled in the trench and was comparatively inexpensive, adding little to the cost of stiffening the arch.

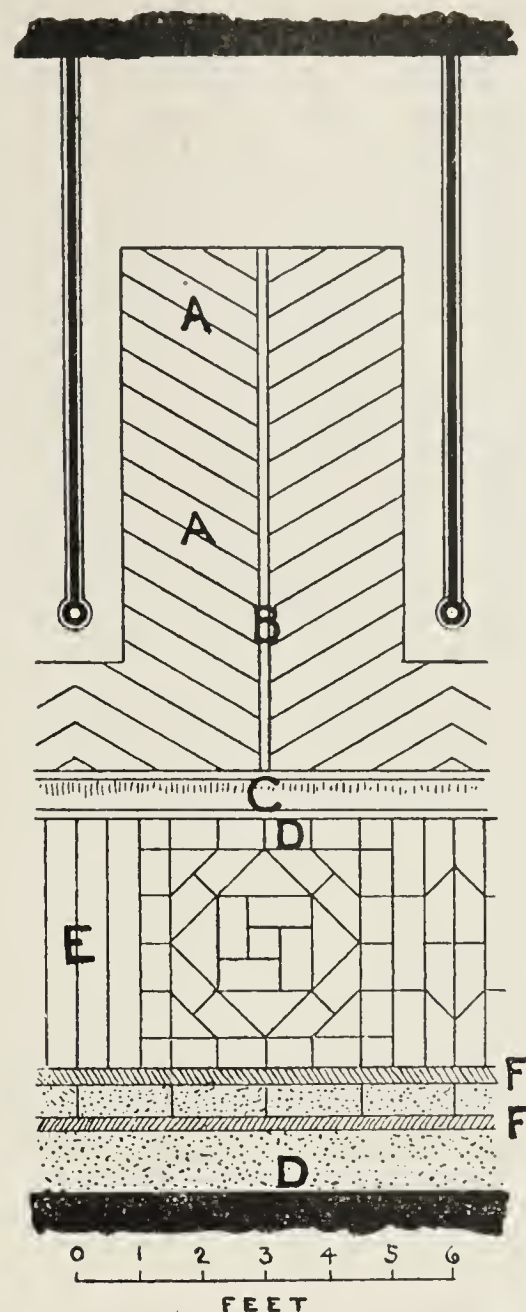
Yours truly,
WILLIAM M. BROWN, Chief Engineer,
Metropolitan Sewage Commission.

In another part of that city, Chief Engineer E. S. Door of the Boston Sewer Department had a similar difficulty, and adopted the same methods, and with the same satisfactory results.

the simplest patterns can be most easily swept clean. Straight grooves across the footway, as shown at E, are at the best in this respect. Plain margins are left around each stall and wall, so as to be more easily swept. The use of diagonal "crimpers" is shown in the border at FF.

A good effect is obtained by adding red or other coloring matter to the concrete of the gangway for the whole or part of its width, as shown by the dotted portion in the figure.

Where brick paving is adopted for stables, etc., it is best to deposit for the reception of the bricks a 6-inch layer of concrete, laid to the proper gradients. The surface of the concrete can be finished with a $\frac{1}{2}$ -inch coat of cement mortar (1 to 1 or 1 to 2), in which the bricks can be bedded; the joints of the bricks should be carefully made with the same mortar, and then grouted over with neat



cement grout.—*Concrete: Its Nature and Use*, by G. L. Sutcliffe.

WANTED—The agency for a good reliable Portland sidewalk cement. If quality and prices are right will take entire output.

JOHN DRUECKER, Chicago.

LOUISVILLE CEMENT MILLS RUNNING SHORT ON ORDERS.

The Clark County cement mill closed down Saturday, Belknap's close down this week and Hausdsale in two weeks. The demand is very slack.—*Jeffersonville Ind., Journal*.

The Chicago Great Western railway has just published a tariff making a rate on cement from Chicago and Milwaukee to St. Paul, Minneapolis and Minnesota Transfer of 10 cents each 100 pounds.

The Consolidated Wheatland Plaster company, of Wheatland, Monroe county, N. Y., to carry on the business of mining and grinding gypsum and the manufacture of plaster, has been incorporated. Capital, \$50,000, and directors, John M. Horton, of 136 Liberty street; C. Freeman, B. L. Greider and E. N. Sprague, of New York city, and John Vaughan, of Brooklyn.

THE REFRACTORY QUALITIES OF CLAY.

By PROF. EDWARD ORTON, JR., of Columbus, Ohio.
(From *The Clay Record*.)

* * * Without attempting to go into the matter with any thoroughness, it can be said that a clay is a mixture consisting of the mineral, kaolinite or clay substance, with a very wide variety of other minerals, having no definite aggregate composition or proportion. The kaolinite may constitute nearly the whole of the mixture or it may be reduced in amount till it becomes insignificant. The accompanying materials vary similarly in character and amount, so that it is not possible to expect to find two clays which are exactly alike in ingredients and proportions.

The kaolinite has fixed chemical and physical characteristics which are well known and sharply defined. Among the latter plasticity is the essential one, and this quantity is so important that it alone forms the means of deciding whether a mineral mixture can be called a clay or not. If there is kaolinite enough present to make the whole material plastic, we call it clay. If there is not enough, we call it sandstone, or limestone, or an iron ore, or a coal, according to which one of the mineral ingredients is the most abundant and important in its makeup.

These fundamental facts being understood, we can readily see why clays give a great range of refractoriness, for it is only reasonable to believe that each and every one of the minerals entering into this complex mineral mass is certain to have not only its own individual pyrometric behavior, but also that it is certain to affect the pyrometric behavior of the other minerals with which it is associated.

We have before seen that some materials are bases and some acids, or some positive and some negative. And when we know that the commonest of all the associated minerals found in clays comprise the commonest of all negative materials, called silica or sand, and the commonest of the positive elements, such as lime, magnesia, iron and the alkalies, we can readily see that we have no simple problem on hand when we try to forecast the refractoriness which any given clay may exhibit.

Before anything at all can be done in this direction, however, we must, above all things, obtain a clear idea of the pyrometric qualities of the kaolinite itself, which is the soul or essence of the clay. As is well known to you all, clay substance itself, or kaolinite, as it has been christened by scientists, is a simple silicate of alumina, the simplest com-

bination which these two compounds unite to form. Silica is the most abundant material in the earth's crust, and alumina is the next to it in the order of abundance. But while they are both present in innumerable other mineral forms, when mixed with other bases, they form together, few, if any, other compounds than kaolinite.

Silica and alumina are both almost infusible by themselves. We cannot melt pure silica, unless we deliberately go at it to make a furnace which will do so. It can be melted with difficulty by the oxyhydrogen blow-pipe, or it can be melted easily and even vaporized by the electric arc, but these generate temperatures which are beyond all common attainment and above all use in the ordinary metallurgical and ceramic arts. So also with alumina, which alone is a little more infusible than silica, and which nearly vitrifies at the heat of molten platinum.

But compounds of the two elements rarely, if ever, retain the characteristics of their component parts, either in fusing point or in other respects, and, furthermore the fusing point of a compound is nearly in all cases lower than the average of its components and often lower than either alone. To this, kaolinite or silicate of alumina is no exception, though there is less difference here than any other case which might be cited. Its melting point is lower than that of silica or alumina, separately, but only slightly, for it requires a temperature nearly up to the heat of molten platinum, at which silica also fuses.

The importance of this fact can scarcely be overestimated. Consider for a moment what it means to the economy of mankind on this planet of ours. It means that the one material which has been gifted by nature with the supremely useful quality of plasticity, by which we make it take any shape our hearts desire, has also been given the power to become practically indestructible as well; that we can harden into permanence anything which our necessities lead us to model and design.

Pure clay substance, therefore, is refractory. It cannot be melted except in specially designed furnaces, at temperatures above practical use. But, as has been already said, pure clay substance is never found outside of museum specimens. Clays are composed of proportions of clay substance ranging from almost complete purity down to very low and unimportant amounts, and naturally their fusibility fluctuates nearly as widely as their composition.

The refractoriness of a clay, therefore, becomes a study of how these

ever-varying mineral ingredients will affect each other and how they will affect the clay substance by which they are bonded together. And here the same laws come into play inside the anatomy of the clay, so to speak, as were shown to act on simple substances when heated together outside. We saw that a silica brick which could not be melted by heat alone would fail in a few moments if a basic clay was allowed to touch it when hot. Similarly, a clay which unites several ingredients in one body, each of which is in itself infusible, may fail wretchedly when at a low heat when the test comes.

We must, then, observe in a clay two things, if we would form an estimate of its heat-resisting powers. First, we must know how much of its substance is really composed of clay or kaolin; and, secondly, we must know what its accessory minerals are and how much of each.

Not only must we know these facts, but we must also know how to interpret them when they are obtained. And here is the key to the whole subject, after all, in this interpretation of the effect of these different minerals on each other.

Let us consider a very few of the principal minerals which we are certain to find in almost every clay.

First and foremost comes silica, quartz or sand, as it is variously called. This is an omnipresent ingredient of clays. None can be found which are absolutely free from it, and in most it constitutes a large, and often the principal, part. Now, the common and accepted idea among clay-workers, until very recently, has been that silica is an advantage to the refractory qualities of a clay. Indeed, I doubt not that if a vote were to be had among this assemblage many of you, possibly the majority, would be found in possession of that idea. Indeed, it is more than likely that some of you would arise as champions of the sand and say—not without truth, either—that you know of your own personal knowledge and from results of your own personal experience, that sand increases the refractoriness of your clay.

This fact cannot be gainsaid, but it will be my endeavor in a few moments to show how this apparent contradiction can be satisfactorily cleared up.

Some few years ago this subject was studied by the late Dr. Seger, in Berlin, who, with that wonderful clearness and simplicity which characterize all of his work, has presented the truth to us in a way which will never require improving.

Taking a pure white burning kaolin, which will endure a tempera-

ture nearly up to the melting point of platinum, he mixed with it in aliquot proportions pure white silica. His mixtures had molecular formula and percentage composition shown in the following table:

CHEMICAL FORMULA.	MOLECULAR PARTS.		PERCENTAGE COMPOSITION.	
	Clay.	Sand.	Clay.	Sand.
Al_2O_3 2 SiO_2	1	0	100.00	0.
Al_2O_3 2.5 SiO_2	1	$\frac{1}{2}$	89.60	10.40
Al_2O_3 3.0 SiO_2	1	1	81.19	18.81
Al_2O_3 4.0 SiO_2	1	2	68.34	31.66
Al_2O_3 5.0 SiO_2	1	3	59.00	41.00
Al_2O_3 6.0 SiO_2	1	4	50.72	49.28
Al_2O_3 8.0 SiO_2	1	6	41.84	58.16
Al_2O_3 10.0 SiO_2 ...	1	8	35.05	64.95

From this but one deduction is possible, and that is that the silica has reduced the refractoriness of the clay. And as these are not theoretical considerations, but practical trials, there seems no escape from this deduction.

Seger's further experiments showed that silica reduces the refractoriness of a pure clay even up to the proportion of seventeen molecules of silica to one of alumina, or in per cents up till the free silica amounts to about 77.7 per cent and the kaolinite to 23.3 per cent of the clay mixture. After this point the continued additions of silica to the kaolin began to increase the melting point, gradually approximating to the melting point of pure silica, as the kaolinite becomes less and less.

It must be observed, however, that, after all, the total amount of this reduction in fusing point is not so very much in actual temperature. The whole of Seger's series, from the highest to the lowest, required temperatures greatly above that of a glowing whiteness. Indeed, the lowest point in the series is much above the fusing point of pure wrought iron or nickel, which requires 1,500 degrees C. at the least, which is a heat far in excess of that used in most of the metallurgical or ceramic industries. So that these differences produced by sand, on the fusing point of a clay would be of no importance, if there were no other minerals present than the clay and sand, or unless we needed for some special purpose the very maximum refractoriness which clay can be made to yield.

Unfortunately, purity is easily obtained in a series of laboratory trials, but not in practical work. We must use such clays as can be had at reasonable prices and in large amounts, and as such clays invariably contain other ingredients than clay and sand, we must look further into the matter before we allow free entry of sand into our mixtures.

To Dr. Richters, another German chemist, we owe the next important step in completing our information on the subject. In his now classic

researches he showed, among other things, that while the various bases, such as iron, lime, magnesia and the alkalies could attack and fuse even a pure kaolin at high temperatures, that their activity was very greatly stimulated by the presence of a little free silica or sand. Now that we know this fact, it seems only reasonable and rational that it should be so. We always feel so about great discoveries after some master mind has presented them to us. For pure kaolin is silicate of alumina, already combined before the heat test begins. Moreover, it is refractory by and in itself. The presence of other bases, like lime and iron, is unfavorable, of course, but they did not find anything of opposite chemical affinity with which to combine, for the alumina has already gotten all the silica pre-empted. Hence, great heat and large quantities of fluxes are necessary if we expect to break down a kaolin in this manner. But suppose there exists free silica; we now have the two chemical sexes present; when the heat rises combination will naturally ensue, as neither base nor acid are attached chemically to the clay substance. As a result a fluid slag is formed which in turn acts as a solvent to the hot clay substance. Its operation is not unlike that of a lump of sugar whose lower surface is dipped into water and allowed to absorb by capillary flow until the moisture appears on its upper surface. If this lump is tested with a knife, it is still hard and sound, though damp. If it is set aside for a few moments, it will be seen to have melted into a syrupy pool. It seems incredible at first that the small amount of water in this hard lump of sugar would exercise so important an effect. And in a clay it is equally wonderful how far-reaching is the effect of a small quantity of slag-forming ingredients under high heat.

This, then, is the one first great law of refractory clays: "No clay can have high refractory qualities if it contains any appreciable quantity of free sand." For even if the clay contains naught else but sand, and if it will endure high heats when tested by itself, there still remains the fact, that contact with any kind of basic matter at any time when hot will result in the surface slagging and gradually wasting away, and as the dripping and flowing of the surface proceeds, new surface of the clay are constantly exposed to the fatal contact with bases. It matters not from what sources these basic substances may come. They may be slags or coal ashes or sparks of molten metal—their action is the same in any case.

This explains why so many clay workers have failed to reach success

in entering the field of fire brick making. Scarce a month in the year passes in which some one does not write to ask my advice as follows: "I have a fine white burning kaolin clay and also a fine white sand. I wish to enter the fire-brick business and would like to know how to mix these to the best advantage." They reason that clay is infusible and sand is infusible; that the shrinkage of the clay will be controlled by the unplastic sand, and that from the two an ideal brick will result. Not infrequently they refuse to accept the above principles as true, and persist in a trial before they are convinced. There are still other reasons which cannot now be taken up, connected with the shrinkage and physical strength of the product which prevent any mixture of kaolin and sand being well received in the trade.

The electric underground conduit service of Berlin, Germany, is constructed of cement pipe.

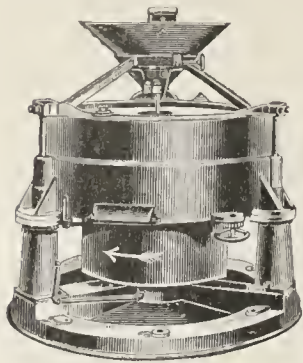
The United States government has appropriated \$20,000,000 for coast defense purposes. This will create a demand for cement, so largely used in coast defense work.

War has greatly increased the business of the Maryland Cement company, Sparrows Point, Md., and the factory is running night and day on an order of 30,000 barrels of cement for the fortifications at North Point, Hawkins Point and Key West.

A thoroughly competent Portland cement manufacturer expert will take a position on salary combined with an interest in the plant will superintend erection of plant, select and install machinery and assume entire management of enterprise. References exchanged. Address C. A. C., care CEMENT AND ENGINEERING NEWS.

WANTED—Situation as salesman or manager of sales department, for a first-class American Portland cement plant. Have been in the lime cement and plaster trade as a manufacturer for years and have a large acquaintance in this line all over the country. If in want of a first-class man address M care CEMENT AND ENGINEERING NEWS, Chicago, Ill.

The Garden City Sand Co. of Chicago has issued a small pamphlet covering the influence of various kinds of sand in concrete work. It contains much exact data that will be of value. The engineer and cement worker who wishes to be informed on pertinent matter relative to many of the intricate problems of the setting of cement will come in contact with new ideas in perusal of the pamphlet mentioned, which can be had on request by addressing as above.



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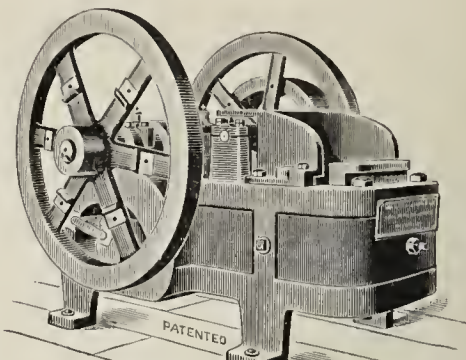
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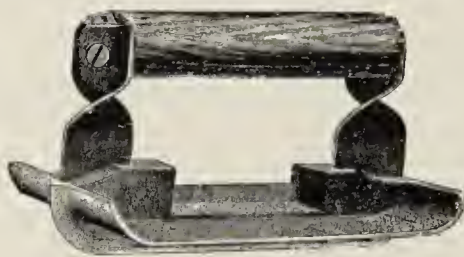


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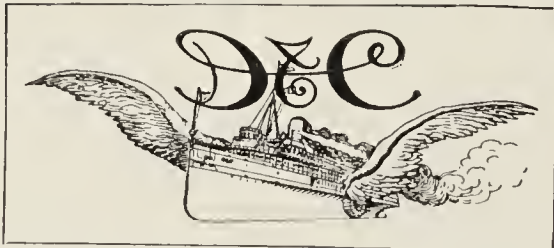
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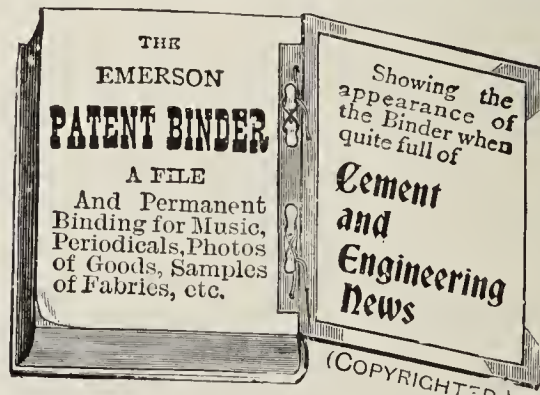
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THOMAS T. JOHNSTON, C. E.,
ASSISTANT CHIEF ENGINEER, SANITARY DISTRICT OF CHICAGO.

Mr. Johnston was born in Cincinnati, Ohio, August 8, 1856, of Alexander and Mary Johnston. Having completed his rudimentary education he entered Rensselaer Institute, Troy, N. Y. Graduating from that institution, he was appointed assistant engineer on the U. S. Engineer Corps, which position he held until 1886, when he was appointed assistant engineer of the Chicago Water Drainage and Water Supply. In 1887 he was appointed Assistant City Engineer of Chicago, and in 1888 he was appointed Chief Engineer of the Artesian Water Company of Memphis, Tenn. In 1890 he was appointed principal assistant engineer of the Sanitary District, Chicago. Since 1891 he has been a consulting engineer. He was the engineer and designer of the water works of Savannah, Ga., Memphis, Tenn. and Waco, Tex. In 1892 he was appointed Assistant Engineer of the Sanitary District of Chicago and has special charge of the concrete work in this undertaking. The Memphis Artesian Water Works, constructed by him, are the best example of artesian water supply in the United States. He has immediate charge of all important matters connected with the Drainage Canal, especially those pertaining to hydraulic work. In 1895 Mr. Johnston was elected vice-president of the Western Society of Engineers and in 1897 president of that organization.

CHANGING THE FORM OF STONE UNDER PRESSURE.

Experiments conducted at McGill University, Montreal, by Professors Adams and Nicholson, have resulted in the discovery that by pressure marble can be molded into any desired form while retaining its strength.

The discovery shows, however brittle a rock may seem to be, it is in reality a plastic substance, capable of flowing into new shapes. The experiments so far have been made chiefly with pure Carrara marble and the process is thus described in detail by Prof. Adams: Columns of marble two centimeters and two and one-half in diameter and about four centimeters in length are very accurately turned and polished. Heavy wrought iron tubes are then made, imitating the plan adopted in the construction of ordnance, by rolling long strips of Swedish iron and welding the strips to the bar as they are rolled around it. When the welding process is completed, the core of soft iron, around which the Swedish iron has been wound, is drilled out, leaving a tube of welded Swedish iron six millimeters thick, and so constructed that the fibres of the iron run round the tube instead of being parallel to its length. The tube is then very accurately fitted onto a column of marble. This is accomplished by giving a very slight taper to both the column and the interior of the tube, and so arranging it that the marble will pass only half way into the tube when cold.

The tube is then expanded by heating so as to allow the marble to pass completely into it, and at the same time leave about three centimeters of the tube free at either end. On allowing the tube to cool, a perfect contact between the iron and the marble is obtained, and it is no longer possible to

When the marble has been firmly placed in position in the tube, an accurately fitting sliding steel plug is inserted in either end, and by means of these the marble is submitted to a pressure far above that which would be sufficient to crush it if not so enclosed. The machine employed in obtaining the pressure is so arranged that it (the pressure) might be maintained for weeks, or even months. Under these circumstances the conditions of pressure to which the marble is subjected are those to be found in the "zone of flow" of the earth's crust.

Under pressure applied gradually, and in some cases continued for weeks, the tube is found to slowly bulge until a very marked enlargement of the portion surrounding the marble takes place. The tube is then cut longitudinally, along two lines opposite to one another. The marble within is found to be firm, so that it holds the respective sides of the iron tube so tightly that it is impossible without mechanical aids to tear them apart. By means of a wedge they can be separated, the force of the blow frequently splitting the marble through longitudinally. In one experiment a column of marble was reduced from 40 to 21 millimetres in height. The deformed marble differs from the original rock in having a dead white color, the glistening cleavage faces of calcite being absent. Although not so hard as the original rock, it is still firm and compact, especially so when its deformation has been carried out slowly. No accurate measurements as to its strength have yet been made, but it will withstand a very sharp blow, and fragments of it weighing ten grams have been allowed to fall from a height of over eight feet onto a wooden platform, rebounding without breaking.

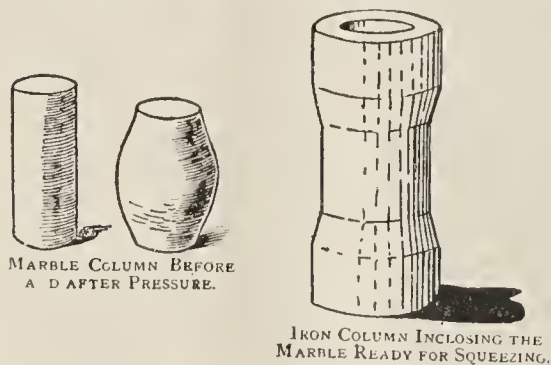
Limestone and marble, even when dry and at ordinary temperatures,

ments set up developing many structures characteristic of rocks which have been squeezed or folded in the deeper portions of the earth's crust.

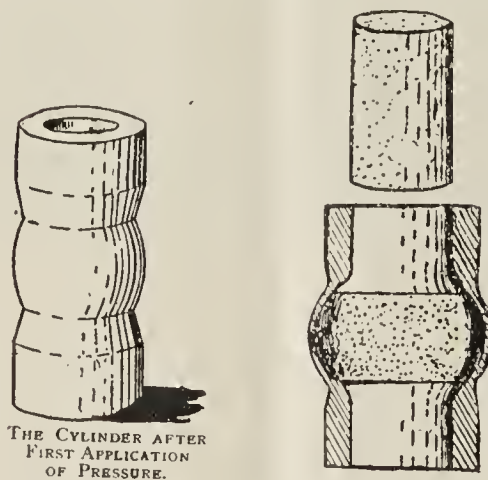
Professor Adams and Nicholson design to reproduce more accurately, if possible, the deformation and cataclastic structure of the interior of the earth. For this purpose they have invented an apparatus capable of generating great heat. With this they propose to surround the iron tube, and, by means of steam and heat, obtain those conditions which surround the plastic marble in the bowels of the earth. It has been shown by geologists that marble and other stone formations become plastic in proportion to the depth they are found in mother earth. Thus, marble found five hundred feet below the surface of the ground is much less brittle than that found, say, at a depth of one hundred feet. The reason for these different degrees of plasticity consists in the fact that the former is subjected to far greater heat and moisture than the latter. By means of their new contrivance Professors Adams and Nicholson are confident that they can reproduce the conditions that prevail far beneath the surface of the earth, and they are awaiting with confidence the results of their future experiments.

The machinery used in all these experiments was designed and manufactured at McGill. The average pressure employed in molding the marble is 80,000 lbs. to the square inch.

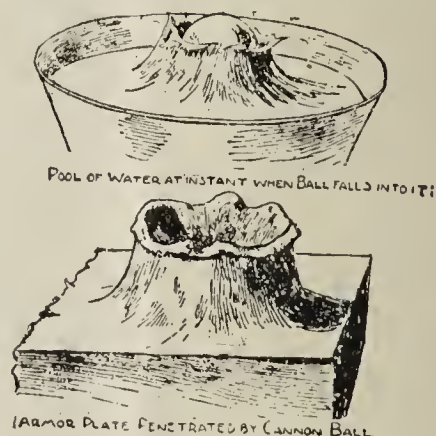
The experiments regarding the mobility of marble are in line with the experiments of the late Prof. Tyndall with solid cubes of ice which are crushed and recombined under



withdraw the latter. Any very slight failure to fit at any point, if such a failure exists in any case, is rendered harmless by the fact that under a comparatively low pressure, the limestone is found to be sufficiently elastic not only to fill up any such minute space, but even to stretch the tube, and, on the pressure being relieved, to contract again to its original form, so that it will drop out of the tube which has been thus enlarged.



possess a certain degree of plasticity and can be made to flow, the move-



pressure into solid and made to conform to various changes of shape in molds and dies used in conducting the experiments.

Prof. Sinclair has recently photographed a bowl of water at the moment a ball dropped from an elevation falls into it. The instantaneous view of the displacement of the water rising around the ball displays the formation of a crater, which is almost identical with the crater-like formation produced by the impact of

a solid shot against a piece of armor plate. The illustrations show the dies, the original and changed form in the material noted above. — Condensed from *The Canadian Architect and Builder*.

ROAD MATERIALS AND CONSTRUCTION.

From *The Canadian Engineer*.

By W. M. WATSON.

When making roads we have the privilege of copying the system of construction used by the makers of the old Roman roads, which are yet sound and firm, and the later methods used by Metcalf, Tilford and Macadam, who revived the Roman and Swedish process of road-making in a lighter and less expensive form. When making a new road the sod and small under brushwood should remain, if convenient, intact, because the rootlets make a tough foundation. In places where artificial banks have to be made to raise the level of the road, or when crossing bogs, marshes and soft places, a good thickness of pea straw or brushwood, etc. should be laid across on the soft material before commencing to build the stone foundation.

When the Romans set out a new road they cut a trench along each side line at least one foot deeper than the bottom of the intended roadbed. These were filled with large boulders or a rough drain was made with outlets at short distances into some natural water course, which efficiently drew off all the water from the under side of the foundations. Macadam rounded his roads a little on the surface, the crown being at the center, giving them a gentle fall to each side. He constructed his roads by laying down three, four or more layers of stone about six inches thick, rolling each layer down even on the surface to the same shape and grade that the road would finish. He suited his material used to the nature of the ground and the traffic that would afterwards use the road, always placing the largest lumps at the bottom, and rubble varying from one inch down to one-quarter inch for the top course, having the whole rolled hard and tight together, but using no sand or soft material except water. Hard frost cannot hurt a road that has a dry foundation.

Short residential streets might be made to fall a little to a central channel only about one inch deeper than the road surface, placed vertically over the main street sewer, having iron storm water girds that would serve both the purpose of ventilating the sewer and drawing the water from the street. This method does away with the nuisance of having costly trapped gullies, with large pockets

filled with decayed matter throwing off disagreeable odors close to the sidewalks and the houses. It saves digging across the streets to the gullies, besides the value of the branch line of pipes from the center sewer to the gullies. It allows the wagons to get close to the sidewalks and gives a width of dry road during a rain storm and frosts near to the houses where it is most needed. It also prevents traffic from passing over the main drain where the road is weakest. Then the roadbed and foundation falling to the center can be easily made to drain itself into the main pipe sewer, and last, but not least, the side of the streets will not be so slippery as under the present system in frosty weather. This method of grading streets is by far the cheapest and the pavement is more durable and healthier for our climate.

We now come to roads suitable for traffic in populous cities, requiring smooth surfaces, and we revive again the customs and road materials used by the old Babylonians, and of Egyptians. There are numerous kinds of materials manufactured for roads and sidewalks that will stand any kind of weather, and that may be got at a reasonable cost, wearing from 20 to 50 years, and always be neat in appearance and comfortable to the wearer during the whole of the material's lifetime.

For instance, where high temperature destructors are used to destroy the garbage, the residuum is a very hard burnt clinker and fine ash. C. & A. Musks, of Bootle, Eng., have invented a press and other machinery to manufacture the clinkers into concrete flags equal to stone, and less liable to retain moisture, and I here give a report published of the manufactory at Liverpool of slabs made from one-third cement and two-thirds clinker, and ash taken from the garbage destroyer.

COST OF MANUFACTURE OF ONE YARD OF CLINKER CONCRETE FLAGGING, TWO AND A HALF INCHES THICK.

Materials	Cost.
* 65 lbs. of Portland cement.....	10¾ d.
† 152 lbs. of clinker.....	nil.
‡ Water.....	¼ d.
Labor.....	5½ d.
Plant contingencies and supervision.....	3¼ d.
Total cost.....	1s. 7¾ d.

The total cost of manufacture is thus about 39½ cents per sq. yd., without reckoning the saving in using the clinkers. The sizes of the slabs that are made are 2 ft. by 2 ft., 2½ ft. by 2 ft., and 3 ft. by 2 ft., each being 2½ ins. in thickness.

Some of these slabs have been laid twelve months and show no sign of

* Varies with cost of cement.
† Really a saving of 1¾ d.
‡ This item could be dispensed with where pressure is obtained by using steam power of destructor.

wear. From the experience already gained, engineers believe that this class of flag will have a life as long, if not longer, than stone, and owing to the porous material with which they are made the clinker paving slabs have a foothold much better than the natural stone.

TESTS MADE AT LIVERPOOL OF MACHINE MADE CLINKER CONCRETE FLAGS, TWO AND A HALF INCHES IN THICKNESS.

Age of flag.	Breaking load applied at center of flag.
4 months.....	1,804 lbs.
4 ".....	1,474 "
4 ".....	1,742 "
4 ".....	1,917 "
4 ".....	1,608 "
4 ".....	1,752 "
6 ".....	2,061 "
6 ".....	1,966 "
4 ".....	1,859 "
4 ".....	1,659 "
4 ".....	1,589 "

Concrete sidewalks made from granite chips and cement are pleasant and safe to walk on for about eight months in the year, the balance they are very slippery and dangerous. Wood sidewalks are slippery in wet weather, unsanitary, and at all times unsuitable. So that something in the shape of slabs that can be taken up and again replaced, and that are not slippery, also having a smooth surface, seems to be in demand. In places where they use a suitable wood set on a well drained, thick concrete foundation, for street pavements, its wearing power is almost equal to good stone, having the advantage of being noiseless and easy for horses' feet. The wood most in favor at the present time in Europe is Australian hard wood, the best being called karri and jarrah. See table of strength, etc., below, prepared by James P. Norrington, C.E., London, England:

Local Name.	Weight per cubic foot.	Breaking stress in lb. per sq. in.	Elasticity in lb. per square yard.
West Australia. { Karri.....	65.00	215.00	7,070.000
Jarrah.....	56.00	171.00	2,940.000
New South Wales. { Ironbark.....	73.85	25.08	5,526.400
Blackbutt.....	60.69	21.70	3,105.979
Mahogany.....	75.06	19.75	3,741.376
Tallow wood.....	72.06	16.16	2,274.790

Colonel Bell, United States Consul at Sydney, strongly recommends his own countrymen to use the Australian hardwood for paving in place of their own lumber. A test made of wood pavements at Euston Road, London, Eng., by James P. Norrington, C. E., proved that, at the end of three years, the wear of jarrah and karri was only ¼ in., and with yellow deal it was worn down 1½ ins. I suppose our Canadian light cedar blocks would have gone out of sight altogether. The same engineer gives the cost of pavement complete with one ft. thick concrete foundation to be \$3 per sq. yd.

CEMENT IN ONTARIO.

During 1897 the cement industry in Ontario has made satisfactory progress, as shown in the report of the Bureau of Mines. Both the natural rock and Portland cements are showing a large increase of production, and manufacturers are establishing a good reputation for the qualities of the cements they are putting on the market. The increase, however, is not shown in the number of establishments, which are two less now than four years ago; but in number of men employed and amount of wages paid for labor, in quantity of cements produced and in their value there is a gratifying evidence of progress. The number of men employed in these four years has increased from 160 to 231, the wages paid for labor from \$44,878 to \$89,060, the quantity of cement manufactured from 85,903 barrels to 181,495 barrels, and the value of the cement from \$109,834 to \$246,425. The greatest increase, however, has taken place in the production of Portland cement, which has gone up from 30,580 barrels to 96,825 while the natural rock cement has only increased from 55,323 barrels to 84,670. In value natural rock cement shows an increase of \$27,349, while the Portland cement shows an increase of \$109,242. This, no doubt, is largely, if not chiefly, owing to the growing interest in the building of good roads in our towns and cities.

All of the natural rock or hydraulic cement works are now situated along the Niagara escarpment, extending from Queenston, near the Niagara River, to Limehouse, on the main line of the Grand Trunk Railway.

One of the Portland cement works is situated at Shallow Lake in Grey county, where the business is carried on by the Owen Sound Portland Cement Company. New machinery was added during the past year, and new buildings and more kilns are now in course of erection which, when completed early this summer, will bring the output up to over 300 barrels per day. The product of the works is known as the Samson brand, and the manager states that not a single complaint was received last year regarding the quality of the material put upon the market. Both the marl and the clay used in the manufacture of cement at these works are obtained from the bed of Shallow Lake.

The works of the Rathbun Company at Napanee Mills were also enlarged last year, and they have now an estimated capacity of 350 barrels per day. The plant embraces the latest and best developments in Portland cement making and is constructed with a view to produce material of very uniform quality. The clay and

marl are mixed in proportions carefully regulated by chemical analysis, and the slurry is so finely reduced in the mixing mills that it will all pass through a sieve of 100-mesh, or 10,000 holes per square inch. Two new burning kilns were erected last year, making three in all; they are of the continuous type and produce a very uniform, well burnt clinker. In the grinding mill the clinkers are ground to an extremely fine powder, and, so finished, it is conveyed to bins in a new storehouse, which has a capacity of 50,000 barrels. The Rathbun Company's cement is known as the Star brand, but they are now producing a quality called the Silica Portland. The marl for the works is drawn from an extensive deposit on the line of the Bay of Quinte Railway, and the clay from a property adjoining the works.

During the fiscal year ending June 30th, 1897, Canada imported 210,871 barrels of Portland cement, valued in the Trade Returns at \$252,587; so there is yet considerable room for expansion in the industry at home.—From *The Canadian Engineer*.

A PIONEER ENTERPRISE UNDER NEW MANAGEMENT.

The C. H. Rose Co.'s Portland cement works of South Bend, Ind., is one of the oldest purely Portland cement works in the United States, formerly built and operated by Thos. Millan & Son from 1877 to 1892.

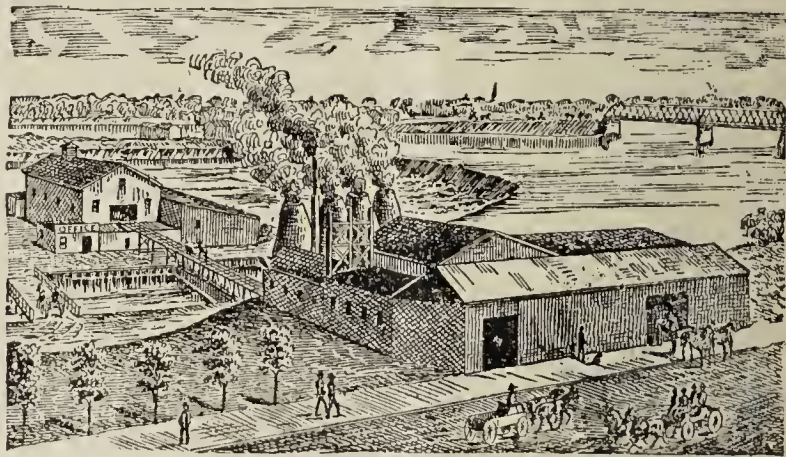
The first kiln was burned in February, 1878, with very satisfactory results; the second kiln was erected in August of the same year to meet the growing demand; a third kiln was erected in 1879 and the fourth in 1880.

The cement found a ready market in the principal cities in the West. The government was one of its best customers, tak-

ing from two to three thousand barrels per year for the U. S. arsenal at Rock Island, Ill. For nearly six years, all of the cement used at the arsenal coming from this plant, the United States engineer in charge of the work recommending the cement as strictly high grade Portland and in every way satisfactory to the government.

The constantly increasing demand, far in excess of the output, caused the formation of a stock company which purchased the Millan interest and erected another and more modern plant which did a successful business. A disagreement between shareholders and a change of management finally led to the shutting down of both plants.

In April, 1897, the C. H. Rose Co. purchased the works and after systematically improving the plant in all departments began the manufacture of cement. The scarcity of coal, brought about by the coal miners strike, caused a short suspension in production. The works resumed and were successfully operated up to January last when they were shut down for more extensive improvements and enlargement which have now been completed and have now doubled their former capacity under the C. H. Rose Co. management and now running up to their full capacity, producing a most excellent Portland cement. The principal office of the company is at 157 and 159 La Salle street, Chicago, Ill.



The C. H. Rose Company's Portland Cement Works, South Bend, Indiana.

IMPORTS OF CEMENT INTO THE UNITED STATES.

WHERE FROM.	APRIL.				TEN MONTHS ENDING APRIL.			
	1897.		1898.		1897.		1898.	
	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.
United Kingdom....	11,431,335	35,705	2,727,406	8,990	160,696,139	522,143	108,443,495	361,753
Belgium.....	13,052,609	38,030	19,687,138	57,415	207,716,543	602,893	192,093,417	578,780
France.....	252,700	1,081	606,300	2,188	9,509,388	27,275	12,317,216	36,076
Germany.....	46,926,981	151,341	30,954,732	102,673	348,480,136	1,143,682	329,170,957	1,105,137
All Other Europe...	1,811,554	7,371	892,800	3,926	9,526,201	36,196	17,442,181	54,423
British North Am...	30,400	132	187,500	900	2,125,300	8,500	1,491,749	7,107
Other Countries.....	.....	.....	.....	.....	802,011	3,872	.....	.....
TOTAL.....	73,595,579	233,660	55,055,876	176,092	738,855,718	2,344,561	660,959,015	2,143,276
Domestic Exports of Cements, bbls.	91,554	439	318,514	1,024	2,477,301	9,195	3,864,305	14,384

There were 3,476,713 lbs. of imported Roman and Portland cements, etc., in the United States bonded warehouses on April 30, 1898, valued at \$9,146, against 7,210,213 lbs., valued at \$20,203, in April, 1897.

Imports of asphaltum or bitumen for April, 1897, were 12,498 tons valued at \$50,026; April, 1898—6,112 tons valued at \$12,454. For ten months ending April, 1898, 74,612 tons valued at \$243,074; for ten months ending April, 1897—81,357 tons valued at \$271,679.

CEMENT AND ENGINEERING NEWS.

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ADVERTISING RATES SENT ON APPLICATION.

"This world belongs to the energetic."

Chicago, June, 1898.

CORRESPONDENCE.

We solicit correspondence on all matters of general interest to the cement trade in all of its branches. Engineering notes, public improvements, and facts and opinions drawn from practical experience will be welcome.

AMERICAN PORTLAND CEMENT MACHINERY.

American methods and machinery applied to the manufacture of Portland cement are attracting the attention of the most conservative European cement manufacturers. The high grade of cement produced by the distinctive American system of manufacture must eventually displace all other systems, especially as practiced in Europe to-day, except where the American system is already in whole or in part installed on the continent.

Notwithstanding the high priced labor in the United States we are to-day producing a more uniform clinker through the instrumentality of the rotary kilns at less cost than the low priced labor and European methods yield under more than one-third of a century's experience and training.

European Portland cement experts have for the last few years been traversing this country investigating the American or rotary kiln system of burning clinker, visiting every cement mill where this system was in use where admission could be had. These visits are now bearing fruit.

The Dyckerhoff company are now experimenting with the rotary kiln system. In other German mills this system has already been installed. Numerous inquiries now reach this country from Europe asking for pre-

cise information on the American rotary kiln system with the view of its adoption. No higher compliment could be paid to American ingenuity in the domain of one of the practical arts than the trend of events indicated in the facts herein narrated.

Our special cement pulverizing machinery is already firmly established in Europe and is cultivating a constantly larger market in Europe. The Griffin mill is meeting with more than usual success abroad, due to its intrinsic merits.

Our American engineers are in constant communication with the most conservative Portland cement producers abroad seeking information on American methods of Portland cement manufacture with the express view of installing the American system. In this respect we are pleased to note that Messrs. Lathbury & Spackman of Philadelphia, Pa., Consulting Cement Expert Engineers, have contracted to install the rotary kiln system in the Aalborg Portland Cement Works at Aalborg, Denmark. The Aalborg Works possess one of the finest plants extant, modeled on the most approved European system and producing one of the highest grade Portland cements imported. The machinery will, in the main, be constructed here and erected in the early fall at the Aalborg works under the personal supervision of a member of the firm. And thus the course of events are taking shape, lifting American talent and ingenuity more prominently into view.

TEMPERING ARMOR PLATES.

When a plate is ready to be tempered it is placed in one of the furnaces and submitted to a severe heat, the size of the plate determining the degree of heat and the length of time required; meanwhile a tempering bath is prepared, composed of a mixture of crude petroleum, fish oil and rosin, the fish oil predominating. The oil is cooled to a temperature of 90 to 100 degrees, it being usually much above that owing to frequent

use. The plate is then drawn from the furnace and submerged in the tank to a depth of six or eight feet, where it is designed to remain until the oil has thoroughly cooled. At this stage it is replaced in the furnace and annealed, this being placed in a pit and covered with cinders, thus allowing the heat to radiate uniformly.

DELIGHTFUL EXCURSIONS.

Great Aggregation of Tourist Points for the Season of '98.

For the Tourist Season of 1898 the Grand Trunk Railway System offers a list of summering places beyond which the tourist need not look for variety, as they will meet every desire, whether for sight-seeing, fashion, hunting, fishing or absolute rest. The itinerary will comprise the following: Chicago to Toronto, Muskoka Lakes, Alexandrian Bay Thousand Islands, River St. Lawrence, Montreal, Quebec, Sagueney River points, White Mountains and North Atlantic Coast resorts.

Chicago to Niagara Falls, Watkins Glen, Glen Summit, Atlantic City, Asbury Park, etc.

Chicago to Petoskey, Bay View, Traverse City, Harbor Springs, Mackinaw and other famous Northern Michigan resorts. Handsome brochures containing full information concerning rates and routes will be sent free to any person interested on application to L. R. Morrow, 103 Clark St., Chicago, Ill.

A GREAT ENGINEERING FEAT.

The east pier of the big bridge of the Northern Pacific Railroad, near Bismarck, N. D., weighing over 9,000,000 pounds, was moved from its foundation, May 28, and slid on rollers to a new foundation, a distance of nearly four feet. This is the first engineering feat of the kind ever accomplished. The pier was 60 feet high, 25 feet wide and 12 feet in diameter.

The time occupied in moving the pier was less than one minute, the engineers being assisted by a slide of earth which slid the entire mass along the steel rollers provided for that purpose in time so short as to be phenomenal.

The work of preparing for the movement has occupied over eight months. The moving of the pier was necessary from the fact that it was being displaced by the sliding of earth beneath the foundation several years ago, and to correct the difficulty permanently it was necessary to build an entire new foundation and move the pier back to the place from which it had been moved. The work was done without interrupting traffic.

CONDITION OF THE PORTLAND CEMENT TRADE IN THE UNITED STATES.

The condition of the cement industry in this country is very active. The cement mills now in operation in this country have found the greatest drawback in not having sufficient cement to supply the demand. The eastern mills in the past five years have always run short of cement to fill their contracts in the early spring.

The production of Portland cement in the United States during the year 1896 amounted to 1,543,023 barrels as compared with 920,324 barrels in 1895, an increase of 552,699 barrels or nearly 56 per cent which sold at an average price of \$1.50 per barrel, in bulk, at the mill. This extraor-

ning of the year 1897 there were eighteen factories manufacturing cement from lime stone or rock and producing 1,203,234 barrels, eight factories using marl and producing 334,789 barrels.

The estimated production of Portland cement in the United States for 1897 was 2,304,300 barrels. The imports of Portland cement into the United States for 1897 was, approximately, 2,255,810 barrels, showing that there is room for a large increase in the American cement industry. In addition to this there was produced in the United States in 1897 about 7,970,450 barrels of Natural or Rosendale cement, a production of 67 factories.

The growth of the consumption of

engineers that one barrel of Portland cement is equal to two of natural and many cases to three, it can readily be seen that as soon as Portland cement is sold at \$1.00 at the mill, in bulk, natural cement manufacturers will be forced to the wall and 4,000,000 barrels per year additional of Portland cement could be used. This is without taking into consideration the steady growth of the consumption of cement, which, as we have stated above, was almost 200 per cent between 1880 and 1890. But supposing even the impossible condition that the cement consumption should not increase, there would be ample market to take up any increased production that may take place in the next ten years. Taking importations



MASONRY WALL LAID UP WITH NATURAL CEMENT MORTAR ON NATURAL ROCK FOUNDATIONS.—SECTION 5, LOOKING TOWARDS LAMONT, CHICAGO DRAINAGE CANAL.

dinary increase taking place largely in the Lehigh regions. In 1896 there were 26 mills in operation in the United States and the imports of Portland cement for the same period was 2,989,597 barrels, a slight decrease over that of the preceding year. The amount of cement imported for the last six years has been remarkably uniform; the total for 1896 being almost exactly equal to that of 1891, the percentage of total consumption having grown from 3,443,126 barrels to 4,447,134 barrels in 1896, an increase in five years of over 1,000,000 barrels notwithstanding this being a period of general business depression.

In the United States at the begin-

ning of the year 1897 there were eighteen factories manufacturing cement from lime stone or rock and producing 1,203,234 barrels, eight factories using marl and producing 334,789 barrels.

Year.	Pounds per capita.
1850.....	6.46
1860.....	10.49
1870.....	12.77
1880.....	13.04
1890.....	33.93

These tables show a remarkable increase in the last ten years. Between 1880 and 1890 the increase in consumption was almost 200 per cent over 1880.

The average price at which the natural rock cement was sold in 1897 in bulk at the mill, not including cost of packages, was 50.8 cents per barrel.

As it is universally admitted by

at 3,000,000 barrels and the natural rock production at the rate of one barrel of Portland to two of Natural, would make 7,000,000 barrels to be consumed in this country, in addition to what the mills can already supply, or an increase in the daily production of about 23,000 barrels over the present daily production of about 5,300 barrels.

The very notable shortage of last fall has extended to this spring's trade and all of the eastern mills have already contracted for their production at prices ranging from \$1.40 to \$1.65 per barrel, in bulk, at the mill. The daily consumption of Portland cement in the United States in 1897 was about 16,000 barrels, assuming

the consumption of Portland cement will continue to increase in the same ratio as in the past ten years the American manufacturers will still have to displace 3,000,000 barrels of imported cement. OBSERVER.

U. S. MINERAL PRODUCTION.

The accompanying table gives the completed statistics of the production of minerals and metals in the United States, as collected and arranged for Volume VI. of "The Mineral Industry," now in press. This table is the most complete presentation of the results of a year's work in the mineral industry which has ever been made.

The total value of the mineral production of the United States in 1897 was, \$746,230,982, against \$737,958,761 in 1896. The values are generally at the mine or works; with a few of the principal metals—such as lead, copper or zinc—this is not possible, and their values are taken at leading markets.

The total value of the output in 1896 exceeded that of the mineral and metal production of all Continental Europe, and nearly doubled that of the United Kingdom, whose mineral output in 1896 was about \$340,000,000, while that of Germany, about \$300,000,000, that of France about \$110,000,000, and that of Belgium \$100,000,000.

The output of building stone is estimated at \$30,000,000 in 1897 as against \$30,599,804 in 1896.

Coal and Coke—The production of coal included 52,645,133 short tons of anthracite, 147,557,599 tons of bituminous and 56,511 tons of cannel; a total of 200,259,243 short tons against 187,657,250 tons in 1896. The increase was in bituminous coal. The production of coke in 1897 was 12,742,340 short tons, an increase of 2,382,325 tons over 1896.

Iron—The make of pig iron increased from 8,623,127 long tons (\$91,577,610) in 1896 to 9,652,680 (\$92,677,312) in 1897. The production of iron was 16,000,056 long tons (\$31,200,889) in 1896 and 18,316,967 (\$31,138,844) in 1897.

Gold—Production increased from 2,558,433 troy ozs. (\$52,886,209) in 1896 to 2,864,576 (\$59,210,795) in 1897.

Silver—Production decreased from 58,488,810 troy ozs. in 1896 to 56,457,292 troy ozs. in 1897.

Petroleum—The production of crude petroleum increased from 55,254,795 bbls. (\$65,753,206) to 56,985,643 bbls. (\$44,804,962.) There was a considerable increase in the output of the Appalachian field and in California. The Lima field showed a small decrease.

MINERAL PRODUCTION OF THE UNITED STATES IN 1897-8.

Compiled for THE MINERAL INDUSTRY, Vol. VI.

By Richard P. Rothwell, editor of the *Engineering and Mining Journal*.

Number.	Products.	Cus- tom- ary Meas- ures.	1896.				1897.			
			Quantity.		Value at Place of Production.		Quantity.		Value at Place of Production.	
			Customary Measures.	Metric Tons.	Totals.	Per M. Ton.	Customary Measures.	Metric Tons.	Totals.	Per M. Ton.
NON-METALLIC.										
Abrasives:										
1	Carborundum.....	Sh. T.	595	539	\$365,612	j\$0.68	621	563	\$153,812	j\$0.27
2	Corundum.....	Sh. T.	250	227	35,000	151.19	230	209	32,200	151.07
3	Crushed steel.....	Sh. T.	326	296	50,624	171.00	321	294	51,821	176.00
4	Diatom. earth.....	Sh. T.	3,510	3,211	34,200	10.65	3,000	2,721	30,400	11.17
5	Emery.....	Sh. T.	1,550	1,406	108,500	77.17	1,500	1,361	105,000	77.15
6	Garnet.....	Sh. T.	2,410	2,214	85,400	38.57	2,260	2,050	79,100	38.57
7	Grindstones.....	Sh. T.	31,301	28,396	294,338	10.36	36,651	33,250	366,675	11.00
8	Pumice.....	Sh. T.	Nil.				1,700	1,542	8,500	5.51
9	Quartz crystal.....	Sh. T.	6,000	5,432	16,500	3.04	6,000	5,432	16,500	3.04
10	Tripoli.....	Sh. T.	1,405	1,275	4,823	3.79	1,631	1,479	5,475	3.70
11	Whetstones.....				105,201				80,220	
12	Alum.....	Sh. T.	14,090	12,782	422,700	33.07	15,456	14,021	468,680	33.07
13	Aluminum sulphate.....	Sh. T.	42,240	38,319	1,056,000	27.56	46,355	42,053	1,158,875	27.56
14	Ammonium sulphate.....	Sh. T.	257	233	10,280		3,111	2,822	121,410	
15	Asbestos.....	Sh. T.	716	650	12,670	19.49	770	698	15,100	22.06
16	Asphalt.....	Sh. T.	20,414	18,519	362,500	19.58	27,397	24,851	486,620	19.58
17	Asphaltic limestone.....	Sh. T.	5,000	4,536	55,000	12.12	2,390	2,168	11,450	5.28
18	Bitumin's sandstone.....	Sh. T.	51,956	47,134	132,500	2.81	41,185	37,363	125,555	3.36
19	Barytes.....	Sh. T.	21,900	19,867	87,600	4.41	27,316	24,781	109,264	4.41
20	Bauxite.....	L. T.	17,096	17,369	42,740	2.46	20,590	20,919	41,180	1.97
21	Borax (crude).....	Sh. T.	13,320	12,084	266,400	22.04	19,400	17,599	388,000	22.05
22	Bromine.....	Lb. . .	559,285	253	143,074	j0.57	487,149	221	136,402	j0.62
23	Calcium carbide.....	Sh. T.	860	780	48,000	61.54	1,925	1,746	134,750	77.17
24	Cement, nat. hydraul.	Bbls a	7,407,311	1,007,980	4,385,962	4.35	7,781,377	1,058,883	4,127,124	3.90
25	Cement, Portland.....	Bbls b	1,577,283	286,181	2,502,479	8.74	2,272,971	412,405	3,521,489	8.54
26	Cement, slag.....	Bbls c	Nil.				40,000	6,350	60,000	9.45
27	Chrome ore.....	L. T. .	702	713	7,775	10.90	50	51	550	10.78
28	Clay products.....	Sh. T.			65,000,000				960,000,000	
29	Coal, anthracite.....	Sh. T.	48,133,930	42,667,101	86,682,794	2.03	52,645,133	47,759,665	85,857,717	1.79
30	Coal, bituminous.....	Sh. T.	139,468,659	126,525,967	113,401,602	0.89	147,557,980	133,864,599	120,505,982	0.89
31	Coal, cannel.....	Sh. T.	54,661	49,588	146,491	2.95	56,511	51,267	153,145	2.98
32	Coke.....	Sh. T.	10,369,015	9,406,770	17,311,823	1.84	12,742,340	11,563,673	23,367,879	2.02
33	Cobalt oxide.....	Lb. . .	12,825	5,817	17,314	3.98	19,300	8,754	32,810	j 3.75
34	Copperas.....	Sh. T.	11,170	10,133	52,662	5.19	11,924	10,818	56,565	5.23
35	Copper sulphate.....	Lb. . .	48,732,840	22,150	1,953,225	88.18	51,012,945	23,139	2,040,518	
36	Feldspar.....	L. T. .	24,907	25,305	124,251	4.91	20,900	21,234	113,773	5.36
37	Fluorspar.....	Sh. T.	6,000	5,432	48,000	8.83	9,025	8,187	74,456	9.09
38	Fullers earth.....	Sh. T.	11,326	10,275	68,476	6.66	17,049	15,467	91,634	5.93
39	Grahamite (k).....	Sh. T.	1,282	1,163	38,460	33.07	1,756	1,592	52,680	33.09
40	Graphite, crystalline.....	Lb. . .	405,066	j183,709	18,225	j 1.10	993,138	j450,487	44,691	j 1.10
41	Graphite, amorphous.....	Sh. T.	574	520	3,850	7.40	1,200	1,090	11,400	10.45
42	Gypsum.....	Sh. T.	195,553	177,405	583,136	3.29	223,061	202,360	711,952	3.52
43	Iron ore.....	L. T. .	16,000,056	16,256,057	31,200,889	1.93	18,316,967	18,610,038	31,138,844	1.67
44	Litharge.....	Sh. T.	6,500	5,897	540,300	91.57	9,900	8,981	899,100	100.11
45	Magnesite.....	Sh. T.	2,067	1,875	9,715	5.12	1,907	1,730	7,628	4.41
46	Manganese ore.....	L. T. .	162,526	165,126	339,083	2.05	156,787	159,296	332,700	2.09
47	Mica, ground.....	Sh. T.	570	517	9,687	18.73	2,692	2,442	38,218	15.65
48	Mica, sheet.....	Lb. . .	17,630	j7,997	12,528	j1.57	92,335	j41,883	45,615	j 1.09
49	Mineral wool.....	Sh. T.	5,853	5,303	61,614	11.60	5,667	5,141	45,494	8.81
50	Monazite.....	Lb. . .	17,500	8	875	109.37	40,000	18	2,000	111.11
51	Natural gas.....				10,000,000				10,000,000	
52	Paints, metallic.....	Sh. T.	31,865	28,908	342,167	11.15	36,293	32,925	370,594	11.26
53	Paints, ocher, etc.....	Sh. T.	17,835	16,179	178,793	11.05	11,151	10,116	110,165	10.89
54	Paints, venetian red.....	Sh. T.	5,998	5,309	93,586	17.62	4,596	4,169	55,690	10.96
55	Paints, white, red ld.....	Sh. T.	95,955	87,049	7,868,310	90.39	103,235	93,654	9,291,150	99.21
56	Paints, zinc oxide.....	Sh. T.	15,863	14,391	1,189,725	82.67	26,262	23,825	2,100,960	83.18
57	Petroleum (crude).....	Bbls d	55,254,795	7,730,425	65,753,206	8.50	56,985,643	7,972,579	44,804,962	5.62
58	Phosphate rock.....	L. T. .	937,372	952,370	2,812,116	2.95	906,080	920,577	2,718,240	2.95
59	Precious stones.....				200,000				101,000	
60	Pyrites.....	L. T. .	109,282	111,030	292,626	2.63	128,468	130,523	379,699	2.83
61	Salt.....	Bbls e	15,707,908	1,995,017	5,328,250	2.67	13,153,524	1,670,592	4,859,364	2.91
62	Silica, sand & quartz.....	L. T. .	720,399	731,925	1,076,038	1.47	750,000	762,000	1,125,000	1.48
63	Slate, roofing.....	Sq. ft.	699,100		2,260,862	n3.23	895,372		2,695,580	n3.01
64	Slate, manufactures.....				467,578				547,645	
65	Soapstone.....	Sh. T.	14,350	13,018	143,500	11.02	18,974	17,213	189,740	10.91
66	Soda, natural.....	Sh. T.	3,000	2,722	65,000	23.88	5,000	4,536	110,000	24.25
67	Soda, manufactured.....	M. T. .		157,475	3,621,925	23.00		277,072	5,774,656	20.84
68	Stone, for building.....				30,599,804				30,000,000	
69	Stone, limestone (flux).....	L. T. .	3,794,175	3,854,882	1,669,437	0.43	4,247,688	4,315,651	1,868,983	0.43
70	Strontium sulphate.....	Sh. T.	Nil.				40	36	200	5.55
71	Sulphur.....	L. T. .	3,800	3,861	72,200	18.70	1,690	1,717	34,814	20.27
72	Sulphuric acid.....	Sh. T.	1,019,501	921,885	17,331,517	18.74	1,128,741	1,023,987	21,446,079	19.19
73	Talc, common.....	Sh. T.	7,098	6,439	63,585	9.87	9,563	8,675	82,795	9.54
74	Talc, fibrous.....	Sh. T.	51,816	47,007	256,080	5.45	58,826	53,376	288,185	5.39
75	Uranium ore.....	Sh. T.	Nil.				17	15	9,010	600.66
76	Zinc ore, exported.....	L. T. .	2,324	2,361	47,408	20.08	9,251	9,399	211,350	22.48
77	Est. prod. unspecified.....				5,000,000				5,000,000	
Total non-metals.....					484,999,181				481,635,147	
METALS.										
78	Aluminum.....	Lb. . .	1,300,000	j589,676	\$520,000	j\$0.85	4,000,000	j1,814,400	\$1,400,000	j\$0.77
79	Antimony.....	Lb. . .	1,226,000	556	84,717	152.37	1,500,000	680	107,250	157.72
80	Copper (m).....	Lb. . .	479,806,183	217,639	51,003,397	234.35	510,190,719	231,421	56,325,055	243.39
81	Gold.....	Oz. . f	2,558,433	j79,576	52,886,209	j664.60	2,864,576	j89,092	59,210,795	664.60
82	Iron, pig.....	L. T. .	8,623,127	8,761,097	91,577,616	10.45	9,652,680	9,807,123	92,677,312	9.45
83	Iridium.....	Oz. . .					20.25		606	
84	Lead, value at N. Y. . .	Sh. T.	174,792	158,479	10,411,643	54.07	197,718	179,368	11,784,093	65.73
85	Nickel.....	Lb. . .	17,170	j7,788	4,464	j0.57	33,700	j15,286	11,068	j 0.76
86	Platinum.....	Oz. . f	200	j6.21	2,800	450.89	200	j6.21	3,000	482.39
87	Quicksilver.....	Flks g	29,863	1,036	1,104,997	1066.58	26,079	965	991,002	1026.94
88	Silver, comm'l value.....	Oz. . f	58,488,810	j1,819,208	39,245,992	j21.58	56,457,292	j1,756,004	33,755,815	19.22
89	Zinc.....	Sh. T.	77,637	70,432	6,117,796	86.86	100,387	91,070	8,271,889	90.83
Total metals.....					252,959,670				261,538,485	
Grand totals.....					727,958,806				746,173,632	

HANGERS FOR CENTERING IN CONCRETE ARCH SIDEWALK AND FLOOR CONSTRUCTION.

The rapid advance made in the use of concrete in arch fire-proof floor and sidewalk construction in large cities calls for a ready and safe method of supporting and holding the centering in place while the concrete arch work is being formed.

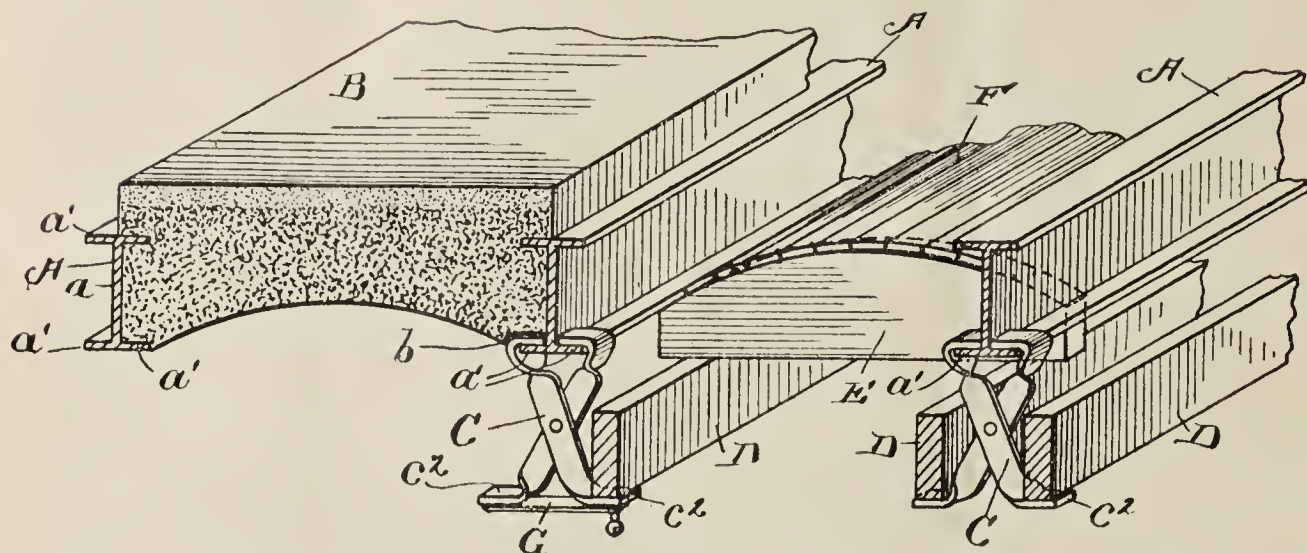
The weight of the arch is at once carried on the steel beams and not suddenly transferred the instant the centering is removed. Messrs. Stamsen & Blome, Unity Building, Chicago, contractors, are the inventors and owners of this system of center hanging and have brought the system into extensive use in heavy and light concrete arch construction in

arch being 10 ft. by 14 ft. and 3 ft. deep at the heel; weight about 15 tons each.

The stock house of the Hoerber Brewing Company, Chicago; the japanning building of the Ames & Frost Company Bicycle Works, Chicago; the Phoenix Tannery Floors, Milwaukee, Wis.; the Concrete Arch Bridge, Garfield Park, Chicago, and much other work of the same nature, all showing the success of the system.

Figure 1 shows a finished arch and the centering in position ready for the material for the next arch.

Figures 2, 3, 4 and 5 show the various details of the hanger construction and use.



There are several methods now in use more or less faulty and cumbersome when critically examined. For instance where the centering is carried on supports resting on the floor below, this relieves the steel beams from carrying the weight of the arch until the centering is removed, when the weight of the mass constituting the arch is suddenly transferred to the steel beams, a slight settling is likely to occur which may result in a slight rupture or distortion in the concrete composing the arch; this is far from desirable.

The true and scientific method of suspending the centering for this class of work is to hang the centering directly from the flange of the steel beam and thus permit any settling of the arch to take place before the concrete has set or hardened the concrete will then adjust itself and conform to the slightest deflection of the steel beams due to the load.

We illustrate a system of carrying the centering which embraces all of the good points noted above and consists of a set of metal hangers so constructed to fold over and embrace the flange of the steel beam by a set of jaws, with arms extending downward to receive and carry a wooden beam parallel with the steel beams, the centering is lowered into position and rests upon the wooden beams ready to receive the concrete mass for the arch. With each increase of load on the centering the hanger increases its grip on the flange of the steel beam.

the business district of Chicago and other large cities in concrete arch sidewalk work and in numerous large buildings in arch concrete fire-proof construction, notably in the several floors of the Gottfried Brewing Company's stable building (Illustrated in September, 1897, issue of CEMENT AND ENGINEERING NEWS.) This particular job being the heaviest concrete floor construction in the United States, the average dimensions of the

Parties having control of 1,000 acres of marl lands, explored by 900 test holes, and an abundance of suitable clay, convenient to the Chicago market, offer 75 per cent of the capital for the erection of a 500-bbl. plant on condition that parties now engaged in the manufacture of Portland cement invest the remaining 25 per cent and assume the entire management of the proposed plant. Particulars to parties qualifying as above.—Address "Ohio," care CEMENT AND ENGINEERING NEWS, Chicago.

The Electric Fire Roofing Plaster Cement Company, of Camden, N. J., was incorporated on June 8th.

An advertisement in CEMENT AND ENGINEERING NEWS brings reward.

Fig. 2.

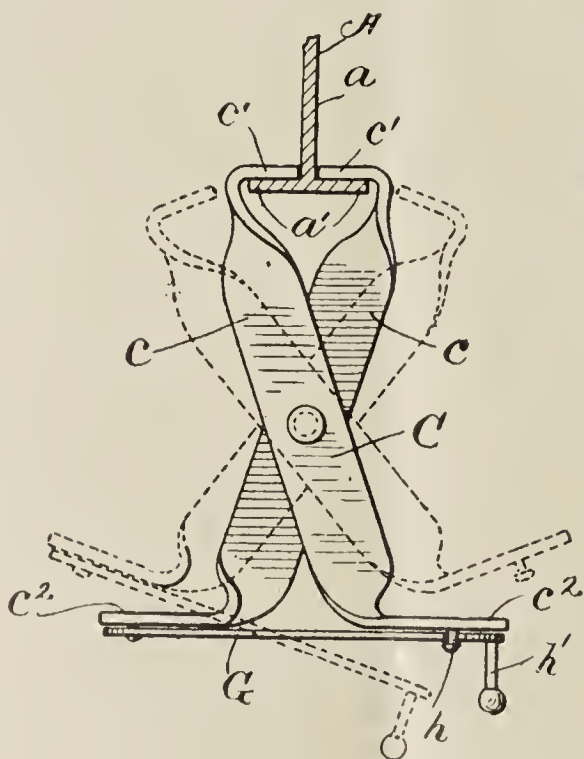


Fig. 3.

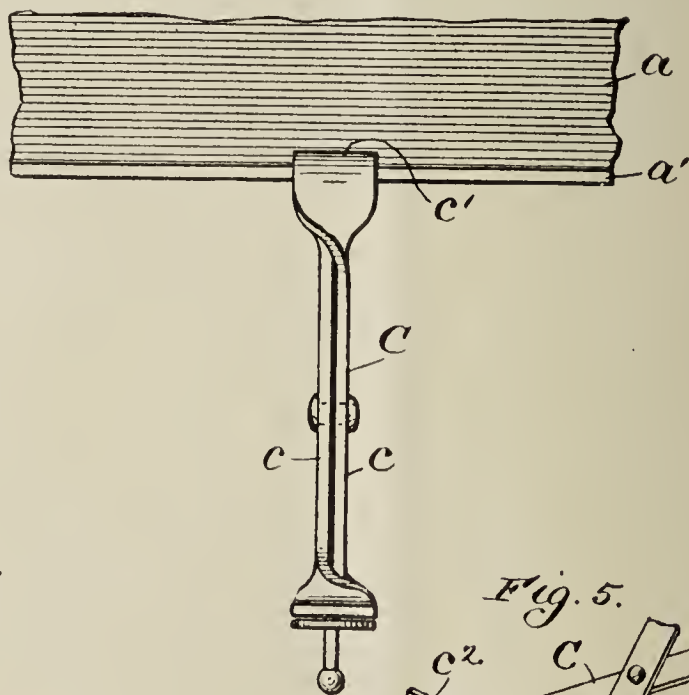


Fig. 4.

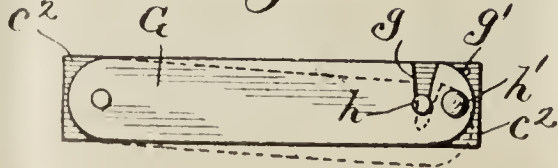
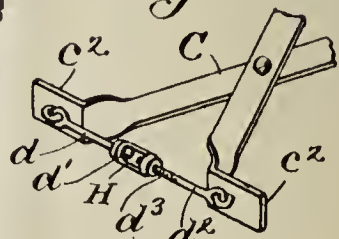


Fig. 5.



BOILING TEST.

During the past few years it has become quite the fashion to boil samples of cement in order to test their qualities.

If one brand sustains the test without serious results it is considered superior to others which fall down during the boiling. This is

A BEAUTIFUL BOOKLET.

The Santa Fe Railway passenger department, Chicago, have issued for circulation a beautiful specimen of the printers' art, entitled "A Colorado Summer," describing the pleasant highways and byways of Colorado's mountain scenery, illustrated with numerous half tone engravings

a summer outing. The war with Spain has in a great measure suspended the flow of travel towards Europe, diverting it to the grand and magnificent scenery of our own country. To this end Colorado offers unusually attractive features via the Santa Fe Railway.

DESTROYED BY FIRE.

The plant of The Portland Cement Co. of Utah, located at Salt Lake City, was destroyed by fire May 31. Insurance \$25,000; loss adjusted at about \$20,000.

The fire originated in the boiler house. The building and machinery are a total loss. The city water supply was not favorably located for effective work in subduing the flames, otherwise the buildings might have been saved.

There is some doubt about rebuilding at Salt Lake City. Mr. Thomas C. Cairns, the general manager has come east with some idea of locating a plant in the vicinity of Chicago.

EXPANDED METAL AND CONCRETE.

The use of Portland cement in connection with expanded metal in the United States is becoming quite large. The expanded metal companies operating in various parts of the country are all talking and recommending expanded metal and concrete floor construction, a single contract for the roof of the municipal buildings at San Francisco amounting to \$147,000.

Every dollar in sales of expanded metal calls for \$2.00 worth of cement. The Portland cement industry should cultivate closer and more intimate business relations with these ten companies. We believe it would be a good stroke of business policy. The Manhattan Concrete Co. of New York are doing all of the actual construction work in this line from New York to Boston.



A GOOD BLAST.—CHICAGO DRAINAGE CANAL.
Raising 700 to 800 Yards of Rock with 1,050 Pounds.

about as wise and logical a conclusion as that arrived at by some of our good old Puritan fathers during the witchcraft craze.

The witch, being thrown into a pond, if she went to the bottom and stayed there, was considered innocent. But if she managed to float she was deemed to be possessed of the devil and was then forced to the bottom on general principles.

By the boiling test many of our very best brands of cements are condemned.

It is safe to assert that of the more than one hundred and fifty million barrels of American rock cements used in all the great engineering works throughout the country during the past fifty years, and with no evidences of failure, not 1 per cent would have sustained the boiling test.

A cement, whether natural or artificial, that will crystallize so rapidly as to sustain the boiling test, ought to be looked upon with suspicion, as it is either naturally too quick setting, or is too fresh and lacking in proper seasoning.—CUMMINGS "American Cements."

The Siegfried's Manufacturing Co. at Siegfried's Bridge, Pa., builders of cement machinery, was destroyed by fire June 8th.

portraying the massive and rugged rocks, lofty mountain peaks, canons, waterfalls, delicate nooks and glens, all of more than passing interest to the traveler, tourist and care-worn professional man seeking recreation. The illustrations are in many instances real works of art, portraying nature's grandest scenery with more than ordinary fidelity. The descriptive matter covers geography, climate, resorts, hotel rates, designating routes, and other pertinent matters designed to smooth the way of the visitor to these delightful regions for



VIEW ON SECTION 12 SHOWING CLAY POCKETS OR FAULTS IN THE ROCK FOUNDATIONS.
CHICAGO DRAINAGE CANAL.

THE HOOVER & MASON CONVEYOR.

Is the largest conveying machine at work on the Drainage Canal, being 640 ft. long, with cantilevers on both sides, carrying at the ends immense sprocket wheels. The illustration shows a line of steel track upon which a steel apron travels. The apron is composed of steel plates, 4 ft. square, carried on trunions at the junction of the plates, the apron is lowered with the channel in a trough of the shape of the cross section of the channel. The excavations are made by plows

in the paper read before the society by Isham Randolph, chief engineer of the Chicago Drainage Canal.

The enlargement of the Vulcanite Portland Cement Co. will take the form of an entirely new and distinct plant, the object being to afford a greater measure of safety against fire by isolating the mills from each other. In the event of one mill being destroyed there will be little interruption of business. Seventeen Griffin mills have been purchased for the new mill.



THE HOOVER & MASON CONVEYOR.—CHICAGO DRAINAGE CANAL.

drawn back and forth by cables operated by steam hoisting machinery across the face of the cut, at right angles to the channel, the plow starting at the top removing immense quantities of material and bids fair to revolutionize all existing methods of excavation. It became less efficient in dealing with lower portions of material to be excavated. Notwithstanding several serious mishaps it is regarded as a success.

The illustrations on the Chicago Drainage Canal are from the *Journal of the Western Society of Engineers*

HIGH PRAISE FOR THE "CONSTITUTION OF HYDRAULIC CEMENT,"
BY S. B. & W. B. NEWBERRY.

"No piece of work on the chemistry of cement comparable with this by Messrs. Newberry has appeared within the last ten years, and we congratulate the authors on the sound method, well-directed industry and clear reasoning which are its characteristics."—*The Engineer*, London, Dec. 24, '97.

Copies of this work will be sent to any address on receipt of 25 cents by the CEMENT AND ENGINEERING NEWS.

NEW CEMENT WORKING TOOLS.

The Orr & Lockett Hardware Co., 71 Randolph street, Chicago, have placed upon the market two new cement working tools which will enable the concrete worker to enlarge the scope of his employment. Figure 1 shows a Corner Trowel used in finishing door steps and other work calling for accurate and highly finished corners. This tool is indispensable for this class of work, saving both time and labor, and at the same time simplifying the undertaking of step work which usually pays better than straight work.

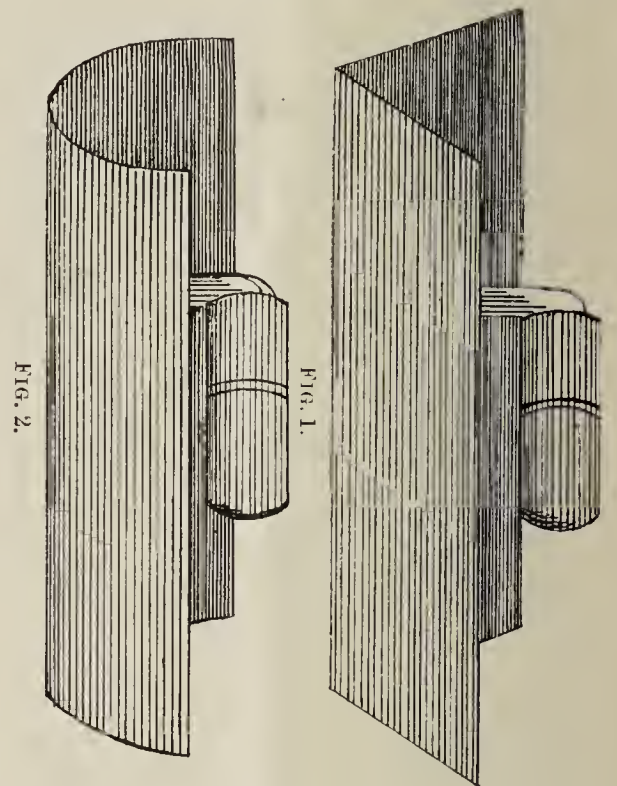


Figure 2 shows a Round Trowel, designed for gutter and curved work and like the corner trowel is a labor saver and enables the artisan to deliver a higher class of work in a shorter time. The Orr & Lockett Hardware Co. are the largest manufacturers and dealers of cement working tools in the world and are constantly bringing out new and special devices in this line. All of their tools are strong and well finished and constructed of strictly first-class materials only.

Mr. B. F. Steadley, secretary, and Gen. Gates agent of the Vulcanite Portland Cement Company called at the office of the CEMENT AND ENGINEERING NEWS and reports a flattering outlook for the Portland cement trade in the Lehigh regions.

The *Scientific American* special naval supplement, published by Munn & Co., 361 Broadway, N. Y., by mail 24 cents, with colored insert map of Cuba, classifies, describes and illustrates the various ships in the U. S. Navy, giving the reader a clear and distinct idea of the efficiency, defensive and offensive, of each class of ships constituting our sea power.

AMERICAN CEMENTS.

By URIAH CUMMINGS.

The author of this treatise has long been engaged in the manufacture of natural rock cement in the United States and the facts and data assembled and the theories promulgated have been drawn from experience and close observation in the actual manufacture and use of natural hydraulic cements, and as the Statistician representing the United States geological department for natural cements, which has brought the author in close touch with the general and individual interest engaged in the production of natural rock cement in the entire country.

The author's mind is thoroughly saturated with the idea that natural rock cement meets every requisite of the engineer and architect. His treatise therefore takes the form of a special plea in favor of natural hydraulic cement. Everything that can be said in its favor will be found within the cover of this book. The facts and data strewn through the pages of history from the time of Julius Caesar to the present day favorable to natural hydraulic cement are presented to sustain the argument advanced.

While scant justice is done to Portland cement within its pages the book will still be valuable to the manufacturer and consumer of Portland cements from the suggestive ideas it contains. The chemistry of cement and the influence of its component parts in the various stages of manufacture and use in the arts, its durability and courses of deterioration are carefully noted. The discovery, history and output, together with chemical analysis of almost every rock cement plant in the U. S. is given.

On the whole, "American cements" is a valuable acquisition to the distinctive American cement literature and should be on the shelves of every student investigating the subject from a purely scientific or practical standpoint of the consumer. We heartily recommend the book, published by Rogers & Manson, Boston, Mass., price \$3.00. Can be ordered through CEMENT AND ENGINEERING NEWS, Chicago.

WANTED—A thoroughly practical Portland cement expert qualified to assume the entire management in the manufacture of Portland cement on a large scale. Address "SYNDICATE," care CEMENT AND ENGINEERING NEWS, Chicago.

Incorporated: The James G. Crispin Lime and Cement company, Cincinnati, Ohio.

Spain has expended \$487,000,000 in fortifications during the past 25 years.

New Portland cement works are projected at Milford, Ind. and Syracuse, Ind.

The interior of the Egyptian pyramids were stuccoed, according to Sir Gardner Wilkinson.

The Mankato Cement Works of Mankato, Minn., has been transferred from Louis M. Fulton of New York to Atwood Collins of Hartford, Conn., as trustee for the first mortgage bondholders.

The Western Lime company was incorporated with a capital of \$100,000. The company will manufacture lime and cement and will have its headquarters in Lawrence county, Indiana and Cook county, Illinois.

The walls of ancient Tyre were built of stone set in gypsum.

Advertising creates a demand for the article advertised. Catch on?

James D. Shearer, assignee of the Twin City Lime and Cement company, Minneapolis, Minn., filed schedules with the clerk of court, showing liabilities \$13,693.68, and assets \$45,669.83, exclusive of a large amount of suspense accounts.

WANTED—Situation as salesman or manager of sales department, for a first-class American Portland cement plant. Have been in the lime cement and plaster trade as a manufacturer for years and have a large acquaintance in this line all over the country. If in want of a first-class man address M care CEMENT AND ENGINEERING NEWS, Chicago, Ill.



DRILLING ROCK.—CHICAGO DRAINAGE CANAL.

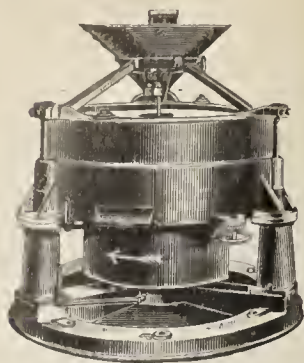
"TO QUARRY MEN AND MINERS— Convert your quarry or mine waste by Hendrickson's method, a commercial product, at low cost, without chemicals. Address "Seaman," 1178 Vanderbilt ave., N. Y."

The Cassadaga Portland Cement Works of Cassadaga, N. Y., are producing 100 barrels per day. New buildings are being erected and new machinery installed under the supervision of W. J. Budd, superintendent and expert of the works.

Incorporated: United States Steel Cement Company, New York; capital \$1,000,000. Incorporators: Geo. F. Averill, Everett Clapp, New York; H. F. Cook, Sag Harbor; William B. Hill, Alexander Cameron of Brooklyn, N. Y.

IN PRESS.—"The Hydraulic Index of the Chatleir Formulas," by S. B. Newberry; and "The Commercial Analysis of Portland Cement," by W. B. Newberry; under one cover. Ready July 10, '98. By mail 25 cents. Address, Cement and Engineering News, 161 La Salle Street, Chicago.

The Buffalo Cement Company, Ltd., of Buffalo, N. Y. manufacture Natural and Portland cement. The manufacture of natural hydraulic cement was established at Williamsville, Erie county, N. Y. in 1824. They now manufacture the Buffalo Portland cement. Both the natural and Portland cements produced by the company have a good reputation and are extensively used. The officers of the company are Lewis J. Bennett, president, James P. Wood, vice-president and treasurer, and Leslie J. Bennett, secretary.



Emery
Mills

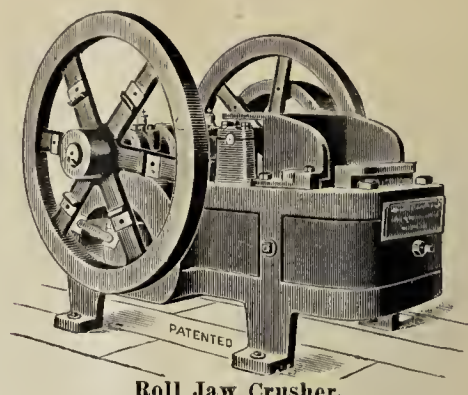
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CEMENT

Only
**Fine
Crusher**

WILL FINISH
5 to 6 bbls. of Portland per hour.
20 bbls. of common cement per hour.

Reduces Portland Clinker to Gravel
and Sand at one operation.
Work of Crusher and Rolls Combined.



Roll Jaw Crusher.

427 Rock Emery Mill.

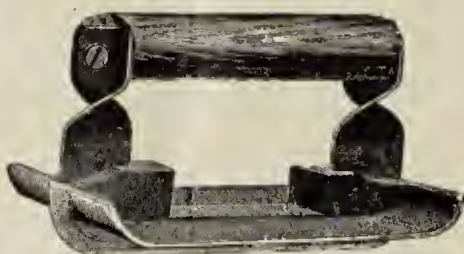
STURTEVANT MILL CO.,

BOSTON, MASS.

**Judicious
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tising**

brings the Producer
and Consumer
closer together

We
Carry
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and other ap-
proved brands.*

ORR & LOCKETT HARDWARE CO.
50 State & 71 Randolph Streets, Chicago, Ill.

PERSISTENT ADVERTISER.

The constant drop of water
Wears away the hardest stone;
The constant gnaw of Towser
Masticates the toughest bone;
The constant cooing lover
Carries off the blushing maid;
And the constant advertiser
Is the one who gets the trade.

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PLEASE MENTION THIS PAPER.

Machines for the Manufacture of

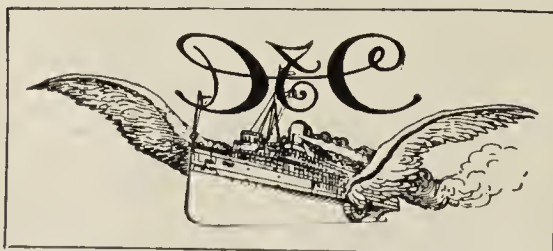
FLOOR AND PAVING PLATES PLAIN, COLORED OF CEMENT AND SAND.

TH GROKE, Machines Manufactory, MERSEBURG (Germany.)

FOR A SUMMER CRUISE TAKE THE COAST LINE

To Mackinac

NEW STEEL
PASSENGER
STEAMERS



COMFORT,
SPEED
and SAFETY

The Greatest Perfection yet attained in Boat Construction—Luxurious
Equipment, Artistic Furnishing, Decoration and Efficient Service.

To Detroit, Mackinac, Georgian Bay, Petoskey, Chicago

No other Line offers a panorama of 460 miles of equal variety and interest.

FOUR TRIPS PER WEEK BETWEEN

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PETOSKEY, "THE SOO" MARQUETTE
AND DULUTH.

LOW RATES to Picturesque Mackinac
and Return, including Meals and Berths.
Approximate Cost from Cleveland, \$17;
from Toledo, \$14; from Detroit, \$12.50.

DAY AND NIGHT SERVICE BETWEEN

DETROIT AND CLEVELAND

Fare, \$1.50 Each Direction.

Berths, 75c., \$1. Stateroom, \$1.75.
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.....AND.....

ENGINEERING NEWS



RESIDENCE OF MR. AND MRS. HERMAN J. HALL, ON WASHINGTON AVE., HYDE PARK, CHICAGO.

Finished in Portland cement mortar dusted with fine Pebbles.

Frank B. Abbott, Architect, Temple Court Building, Chicago.

manhole extending up to the street surface.

It will be readily understood that the most complicated part of the work lies in effecting the connections with the sewers whose flow is to be intercepted, and the renewal or reconstruction of sewers which already exist along the line of the new intercepting sewer. Fig. 3 shows the construction of the concrete masonry retaining wall at the outfall.

The following is an abstract of the more important portions of the cement and concrete specifications for

clay; quarry strippings will not be accepted.

Concrete.—Concrete must be composed of 1 part cement, 3 parts sand and 8 parts broken stone, the stone being wet or washed before the mortar is spread. The cement and sand must be measured and thoroughly mixed dry until of a uniform color, and then wet through a rose head with as little water as will render it proper for use and thoroughly worked. The stone shall be measured and spread about 4 ins. thick on a tight board platform; the mor-

tal cement with 1 part of sand; a moderate quantity of clean water is to be afterwards added to produce a paste of the proper consistency, the whole to be quickly and thoroughly worked with hoes or other tools. Mortar shall be mixed in such quantities as to allow it to be used immediately after being mixed, and the use of the mortar which has been set and then retempered will not be allowed.

The plans and data are from the *Engineering News*.

THE AMERICAN NAVY.

The magnificent practical results obtained by our navy wherever it has been given a free hand justifies the confidence which the American people have ever manifested in its efficiency. Ship for ship, gun for gun and man for man there is no equal. Its splendid sea-going properties, as demonstrated by the Oregon in her 14,000 mile speed trip around the Horn, without impairing her fitness for action, marks an era which has never been equaled by any other sea power. The rapid annihilation of the Spanish fleet at Manila and Santiago, preserve the traditions of the past under new conditions which obtain with new and modern implements of naval warfare. The patriotic instincts of our people desire to see this arm of our national defence strengthened and will not begrudge liberal appropriations to carry out such a policy.

The Alma Portland Cement Co. of Wellston, O., will manufacture from lime rock and clay and will have an ultimate capacity of 1,000 bbls. per day. Messrs. Lathbury & Spackman are preparing the plans and are the consulting engineers for the plant. Mr. C. K. Davis is the moving spirit in this enterprise.

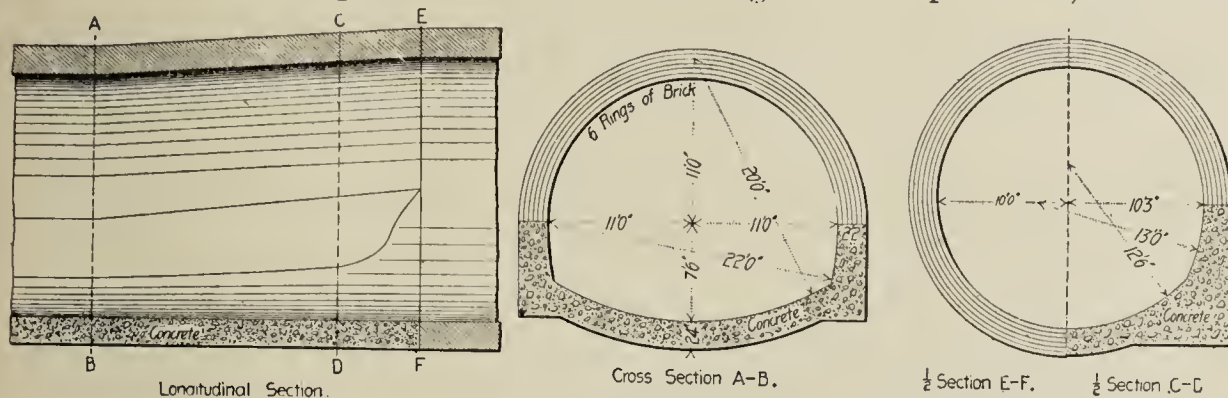


Fig. 2.—Connections Between the Horseshoe and Circular Section of the 39th Street Conduit.

the main conduits on Lawrence Ave. and 39th St.

Cement.—All cement used in brick and stone masonry and in pipe laying must be the best quality of American natural cement, fresh ground; 80 per cent must pass a sieve of 80 meshes per lin. in., and briquettes gaged neat must show a tensile strength of 120 lbs. per sq. in. in 7 days (1 day in air and 6 days in water). The reputation of the cement must have been established by use by the Department of Public Works. All cement used in concrete work must be American or German Portland cement, of reputation known and established by use; 93 per cent must pass a standard sieve of 10,000 holes per sq. in. and a mixture of 1 part cement to 3 parts sand must show a tensile strength of 165 lbs. per sq. in. in 7 days (1 day in air and 6 days in water), with an increase in strength of not less than 33 per cent at the end of 28 days and an additional increase of 15 per cent at the end of three months. As ample time is allowed, the contractor must submit samples of the Portland cement he desires to use, and three to five brands may be approved by the engineer, any of which the contractor may use, subject to daily tests. The contractor must furnish storage and keep at least one month's supply on the work at all times.

Broken Stone.—The broken stone for concrete work must be sound limestone, the largest pieces of which must pass a 1½ in. ring and graduated in size so that the voids shall not exceed 30 per cent. It must be free from dust, or screenings, dirt or

tar shall be spread evenly on the stone, and the whole shall be turned in place with shovels without heaping until each stone is thoroughly coated with mortar.

The concrete shall be quickly and carefully deposited in place, without throwing, and spread in layers not more than 6 ins. thick, and rammed with iron rammers until water shows on top.

All exposed surfaces of concrete, and the back of the retaining wall, shall be plastered with Portland cement mortar made of 2 parts cement and 3 parts sand, not more than ¾-in. thick, applied before the concrete has set hard, floated to a straight edge, and troweled smooth.

Mortar.—All mortar for brick and stone masonry shall be made by carefully measuring and mixing (until of a uniform color) 1 part of nat-

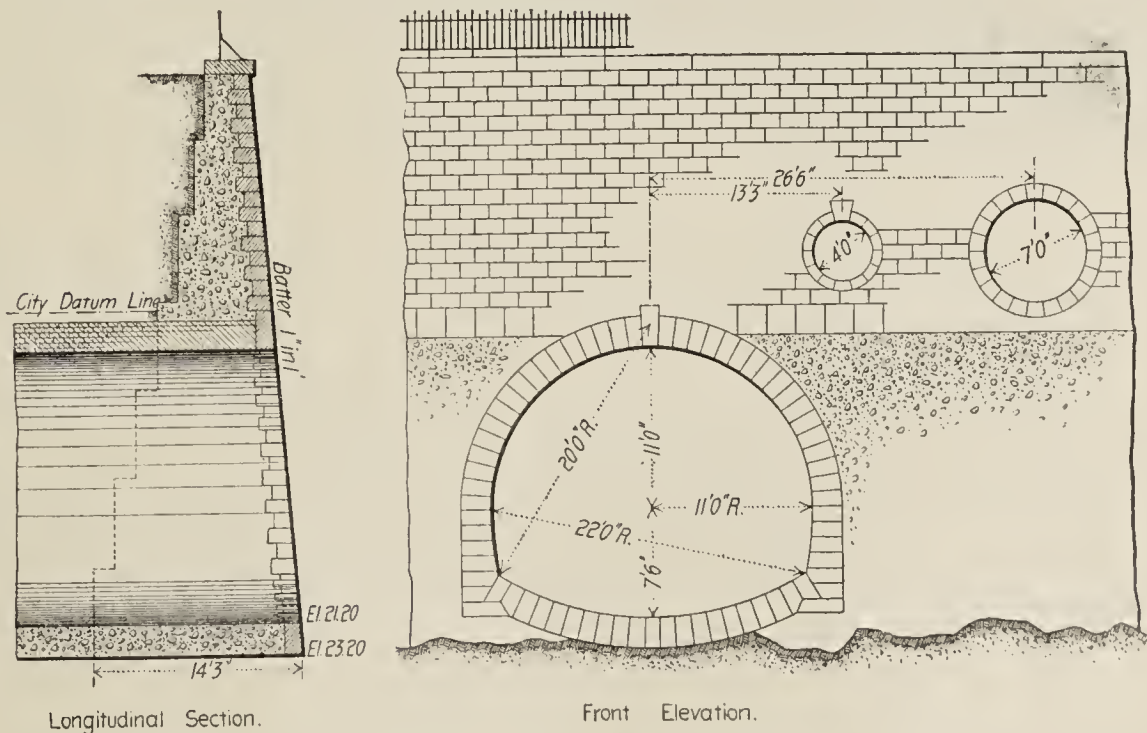


Fig. 3.—Concrete Masonry Retaining Wall at Outfall of 39th Street Conduit.



RESIDENCE OF MR. AND MRS. HERMAN J. HALL, ON WASHINGTON AVE., HYDE PARK, CHICAGO.

Finished In Portland cement mortar dashed with fine pebbles.

Frank B. Abbott, Architect, Temple Court Building, Chicago.

This residence has attracted considerable attention because of its artistic design and arrangement. The exterior covering of this building has much to do with its attractiveness. From the basement wall to a height of four feet all around the building, a wall of irregular blocks of dark sand stone is the weather covering; the porch columns and arches and the port cochere arch are of the same material. From the stone-work up to the eaves, the weather covering of the building is Portland cement mortar dashed with fine pebbles. This cement mortar was applied upon and held in position by metal lath which was stapled to the sheathing boards of the frame work. After the cement was dry it was given two coats of paint in color to harmonize with the general exterior of the building.

CEMENT AND ENGINEERING NEWS.

(PUBLISHED MONTHLY)

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CORRESPONDENCE.

We solicit correspondence on all matters of general interest to the cement trade in all of its branches. Engineering notes, public improvements, and facts and opinions drawn from practical experience will be welcome.

TRANSITION FROM LIMESTONE TO CEMENT IN CHICAGO.

The sharp decline in the output of the limestone quarries at Lemont and Joliet, Ill., during the past three years and the consequent shrinkage of values in stocks of corporations controlling these properties is not a matter of surprise to those actively engaged in the building trade in Chicago. For twenty-five years these quarries controlled the stone trade of Chicago. The flattering outlook which this particular industry afforded caused the organization of a vast corporation with millions of capital, which purchased the small as well as large quarry interests at fancy figures, buying from the people who did not wish to sell, at their own figures. Even under these conditions large dividends fairly earned were declared on millions of stock.

The advent of cement construction soon made inroads and began to displace the stone sidewalk with cement, then came the steel and concrete foundation for the large office buildings, and the combined curb and gutter, until to-day, with few exceptions, the quarry output is, in the main, rubble stone, finding its chief market in foundations for dwellings, rising in scattered and isolated points throughout the city and chiefly in the suburbs, calling for long hauls over unimproved and often impass-

sable streets, while the heavy work in the heart of the city is done with concrete. The limestone trade has seen its best days in Chicago, and while it survives will yearly cater to a constantly declining market, while its young and vigorous rival, Portland cement concrete is extending its sphere of influence on every hand, upon its own simple and intrinsic merits.

THE ENTERING WEDGE FOR CONCRETE SEWERS.

The crushed stone and Portland cement dealers in Chicago have, in the past, made repeated efforts to persuade the city authorities to adopt concrete for sewer construction without the least success. The Chicago brick trust and its purse of gold has succeeded in every instance in persuading the authorities to retain brick for sewer purposes.

We are gratified to note that the city is about to give concrete sewer construction more than a fair trial by its use in both the Lawrence avenue and the Thirty-Ninth street conduits. The peculiar conditions which obtain in the open cut of the Thirty-Ninth street conduit and in the junction chamber of the Lawrence avenue conduit are such as practically bar the use of brick, which answers well enough in the ring or circular form of sewer construction, but not in the invert of the horse-shoe form adopted, here concrete is

eminently suitable.

The issue made by the agents of the brick trust has been, that concrete material would not stand up under the conditions which obtain in Chicago soil. These ideas were so effectively impressed upon the common council that ordinances calling for sewer construction specially prohibited its use. Therefore the use of concrete in the largest and most extensive underground conduits ever constructed in Chicago must effectually silence the heretofore potent cry for brick and give Portland cement an entering wedge in the future sewer contracts let by the city, thereby opening up a larger market for high grade cement.

The bar heretofore imposed against concrete in Chicago has been the cry of greed which has sought to maintain a monopoly on the score of ancient usage and practice engineered in the last few years by the Chicago brick trust, which controls the output of all yards manufacturing common brick in the vicinity of Chicago. This combine levies an annual tribute of 25 per cent on the consumers of common brick in excess of the ruling prices which have been obtained under free and open competition. The expansion of a concrete sewer system for Chicago will bring a much needed relief to citizens contributing to the special assessment rolls for public improvements.

IMPORTS OF CEMENT INTO THE UNITED STATES.

WHERE FROM.	MAY.				ELEVEN MONTHS ENDING MAY.			
	1897.		1898.		1897.		1898	
	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.
United Kingdom....	13,682,492	42,914	2,967,400	10,315	174,378,631	565,057	111,410,895	372,068
Belgium.....	26,267,448	73,875	23,327,164	67,505	233,983,991	676,768	215,420,581	646,285
France.....	2,335,112	7,354	148,800	600	11,844,500	34,629	12,466,016	36,676
Germany.....	61,183,780	195,551	46,717,926	157,958	409,663,916	1,339,233	375,888,883	1,263,095
All Other Europe...	3,776,503	12,325	2,738,302	8,911	13,302,704	48,521	20,180,483	63,334
British North Am....	171,500	824	473,125	2,290	2,296,800	9,324	1,964,874	9,397
Other Countries....	.....	.....	5,200	67	802,011	3,872	5,200	67
TOTAL.....	107,416,835	332,843	76,377,917	247,646	846,272,553	2,677,404	737,336,932	2,390,922
Domestic Exports of Cements, bbls.	3,050	5,858	6,061	11,562	30,907	57,155	46,530	81,911

There were 3,775,585 lbs. of imported Roman and Portland cements, etc., in the United States bonded warehouses on May 31, 1898, valued at \$10,417, against 8,510,574 lbs., valued at \$22,922, in May, 1897.

Imports of asphaltum or bitumen for May, 1897, were 19,453 tons valued at \$57,052; May, 1898—7,437 tons valued at \$22,020. For ten months ending May, 1898, 82,049 tons valued at \$264,094; for ten months ending May, 1897—100,810 tons valued at \$328,731.

CHICAGO PORTLAND CEMENT COMPANY'S NEW MILL.

The destruction by fire of the Chicago Portland Cement Co.'s works at Hawthorne, Ill., early in the year, will be recalled by our readers. The officials of the company after carefully considering the availability of many locations tributary to the Chicago market, have selected Ogelsby, near La Salle, Ill., for the erection of a new plant. The location is an ideal one combining many points of advantage for the economical manufacture and distribution of Portland cement.

The company has a capital of \$250,000, fully subscribed, and have now in process of erection a plant to produce from 500 to 600 barrels of Portland cement per day, with provisions in the plans for doubling this capacity at an early date.

The new site adjoins one of the oldest and best coal mines in Illinois.

The process of manufacturing Portland cement will practically be the German method, forming the raw cement material into brick and burning in vertical kilns of special design of the style heretofore in use by the company, with valuable improvements thereon.

The raw material used is a shell lime (Muschel Kalk) deposit averaging 25 ft. thick with little striping, making easy quarrying. Underlying this rock is a strata of shale clay 5 ft. thick, of fine quality and wonderful uniformity of composition. From the above described materials the highest grade Portland cement can be produced. The company controls 600 to 700 acres of land, all underlaid with this material.

Magnesia.—This shell lime rock carries not to exceed $\frac{8.0}{100}$ of one per cent. of magnesia. The raw material both rock and clay is crushed at the quarry to one-half inch maximum size and then raised by cars on an incline to the main mill buildings for compounding and further reduction.

All necessary materials used in the manufacture of Portland cement are found on the company's property.

The mill site lies between the Illinois Central Railroad and the C. B. & Q. Railroad from which lines independent sidetracks extend into the plant.

The Vermillion River flows on the north side of the land, emptying into the Illinois River opposite the City of LaSalle, $3\frac{1}{2}$ miles distant. From Chicago to the plant is about 100 miles. Shipments over Chicago & Northwestern Railroad, Chicago, Rock Island & Pacific Railroad and Atchinson, Topeka & Santa Fe Railroad can be made with only a small

switching charge added. Bountiful springs are on the land.

The buildings shown on diagram are constructed entirely of steel and concrete with tile roofs, and are absolutely fireproof. Power consists of a Cramp-Hoadley Cross Compound Condensing Engine 750 horse power, made by the Gates Iron Works of Chicago, and three 280 horse power Cahall B. & W. water tube boilers. Twelve Griffin mills will be the first installment for pulverizing raw material and clinker. Ten vertical continuous kilns located in kiln house receive the compound bricks from the drying tunnels on same level as charging floor, bricks being made by one No. 2 giant brick machine manufactured by American Clay Working Machinery Company. Conveying machinery and all labor-saving devices have been abundantly provided.

The works are expected to produce cement in October next.

Officers of company: Norman D. Fraser, president; D. R. Fraser, vice-president; Ralph Gates, secretary and treasurer; Eber C. Preble, superintendent; P. O. Krattnaurer, consulting engineer.

General offices, 803 Stock Exchange Building, Chicago.

HIGH PRAISE FOR THE "CONSTITUTION OF HYDRAULIC CEMENT,"
BY S. B. & W. B. NEWBERRY.

"No piece of work on the chemistry of cement comparable with this by Messrs. Newberry has appeared within the last ten years, and we congratulate the authors on the sound method, well-directed industry and clear reasoning which are its characteristics."—*The Engineer*, London, Dec. 24, '97.

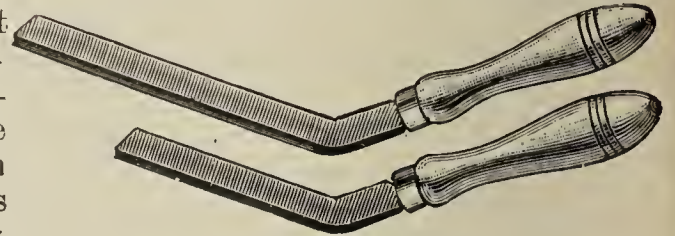
Copies of this work will be sent to any address on receipt of 25 cents by the CEMENT AND ENGINEERING NEWS.

The floors of the new Wells-Fargo Express company's building, San Francisco, Cal., is being constructed under the Ransome system of concrete and twisted iron construction.

CEMENT-WORKING TOOLS.

The Orr & Lockett Hardware Co., Chicago, has placed upon the market a cement-worker's finishing tool made of the best spring steel and highly tempered. The handle is extra large and fastened by an improved method which prevents its working loose.

The tuck-pointing tools shown are conically-shaped for the purpose



Tuck Pointing Tools.

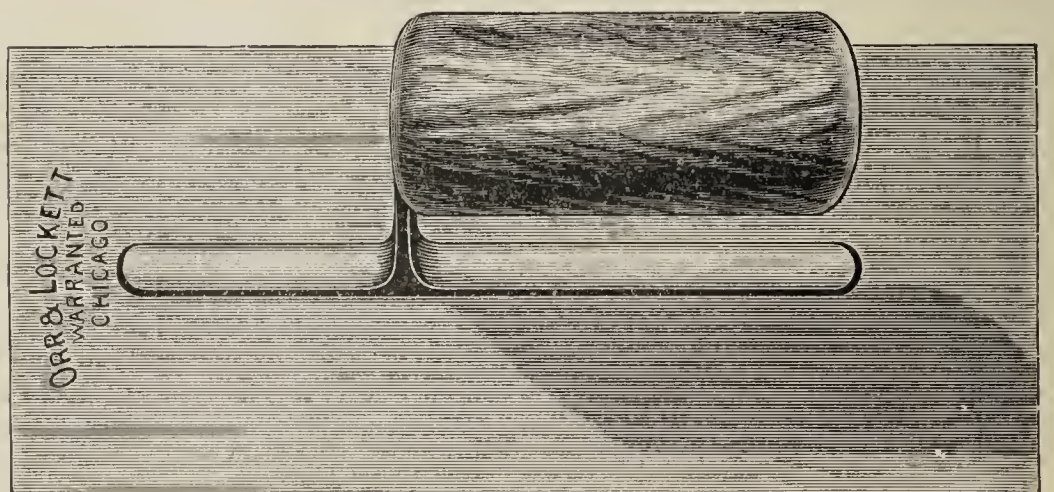
designed and are grooved to form either a square or oval bead, with a special groove at the extreme end of the tool, enabling the artisan to work in narrow and contracted areas. This tool finds its special use in dividing Portland cement plastered walls into blocks in imitation of stone and brick work. This tool is giving excellent satisfaction.

In the latter part of June the price of natural cement in the Louisville cement regions touched 22 cents per bbl. at the mill.

An English company has erected a Portland cement plant on Green Island, China, in the vicinity of Hong Kong. The company has been shipping a part of its product to San Francisco, Cal.

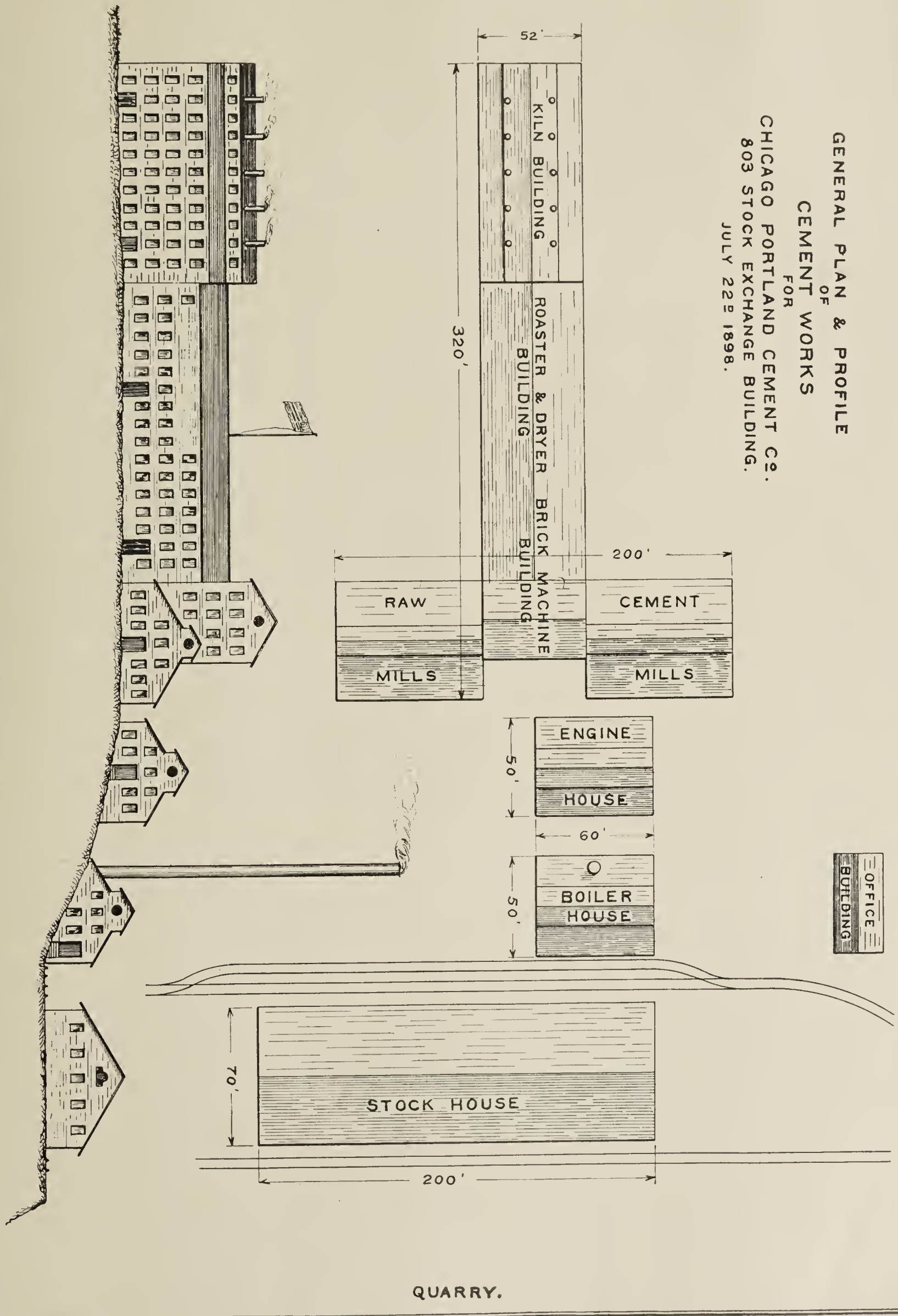
The Peerless Portland Cement Co. of Union City, Mich., started its grinding machinery July 25, for the first time. The plant has 19 upright kilns finished and expect to increase to 60 kilns in the near future.

The Bonneville Cement Co., of Springfield, Pa., manufacturers of the "Star" Portland cement, have resumed operations and are again shipping cement. These works were destroyed by fire in February last. The Garden City Sand Co., of Chicago has just received the first consignment of 10 car loads of the "Star" Portland cement.



Cement Finishing Trowel.

GENERAL PLAN & PROFILE
OF
CEMENT WORKS
FOR
CHICAGO PORTLAND CEMENT CO.
803 STOCK EXCHANGE BUILDING.
JULY 22^d 1898.



MR. CUMMINGS' VIEWS ON THE CHEMISTRY OF CEMENTS.

By S. B. NEWBERRY.

A book entitled "American Cements," by Uriah Cummings, has lately appeared. (Rogers & Manson, Boston, 1898). Mr. Cummings is widely known as a successful manufacturer of natural rock cement, and it is hardly to be expected that his views on the comparative merits of natural and Portland cements will be strictly impartial. In fact, the preface states that "the chief motive which has animated the present work has been a desire to see adequate consideration paid to the claims and merits of American rock cements." We therefore find many pages devoted to a statement of the superior qualities of natural hydraulic cements, and warnings against the dangers of artificial Portland. All of this is natural enough from a manufacturers' point of view, and the reader will take it with a fair measure of allowance. When we come, however, to the chapters on the chemistry of cements we find a state of affairs much more serious. Here Mr. Cummings advances a series of views which are entirely opposed to those held by leading cement chemists. These views are, for the most part, based on no experimental evidence, and find their only support in quotations from authorities of twenty or thirty years ago, whose ideas have been superseded in the progress of modern scientific investigation. The writer has been a close student of the chemistry of cements for more than twenty years, but is forced to confess that much of Mr. Cummings' reasoning and calculation is too deep for his comprehension. Certain erroneous statements, however, stand out clearly, and these should be briefly noticed, in order that students who may refer to this book may not be led to false conclusions.

The division of American rock cements into "bi-silicates" and "tri-silicates" is purely visionary. It is clearly proved that magnesia forms no hydraulic products with silica and alumina, and that the character of a cement must be estimated from the ratio existing between the acids (silica and alumina) and the lime. Scarcely any of the American rock cements, the analysis of which are given by Mr. Cummings, show sufficient lime for the formation of a bi-silicate (di-silicate) $2\text{CaO}.\text{SiO}_2$. Portland cement, on the other hand, as shown by Le Chatelier and all other modern investigators, consists essentially of calcium tri-silicate, $3\text{CaO}.\text{SiO}_2$, with varying quantities of calcium aluminate, probably $2\text{CaO}.\text{Al}_2\text{O}_3$. Mr. Cummings claims that mag-

nesium silicate has hydraulic properties, but gives no evidence of this except to state that he made good cement by calcining native serpentine, which is essentially a hydrated magnesium silicate. He gives no analysis of the mineral, however, and it is impossible to say to what extent the hydraulic properties of the material were due to lime and alumina which may have been present. The writer has made a number of tests of artificial mixtures of pure magnesia with silica and alumina in varying proportions, and has never found after calcination the slightest sign of hydraulic properties. Mr. Cummings' claim that the theory of the injurious effects of magnesia in Portland cement has been put forward in the attempt to account for cracking really due to excess of lime, is simply utter nonsense, and need not be seriously discussed. The facts in the case are that Dykerhoff, in 1896, presented to the Association of German Portland cement manufacturers the results of a long series of experiments extending over five years, which appeared to show that over 4 per cent of magnesia caused a falling off in strength, while eight per cent of magnesia produced actual cracking after long periods. Other members of the committee opposed the view that magnesia is injurious, and the whole question was referred to a new committee, of which Dykerhoff is chairman, and will be reported on, with the results of most thorough and complete experiments at the meeting in the year 1901. Until then it may be well to reserve our judgment so far as the injurious effect of magnesia is concerned.

Whether magnesia is injurious or not, however, it certainly does not take the place of lime in cements, and the proportion of base to acids must be calculated with reference to the lime only. To a correctly balanced cement mixture any amount of magnesia may be added before burning, without making the proportion of bases too high as shown by the boiling test.

Mr. Cummings tries to prove that magnesia and alumina in cement are chemically combined with silica, by showing that they are only very slightly dissolved out from cement by washing with water. As magnesia and alumina are almost wholly insoluble, even when free, the absurdity of this is apparent. As to Mr. Cummings' statement that the excess of lime above "the true combining proportion," (di-silicate), is dissolved out by water, it need only be said that *all* the lime can be removed from cement, and most of the silica also, by prolonged washing.

Mr. Cummings gives, on page 93,

an elaborate calculation and statement of what will take place on calcining gypsum with clay, claiming that a di-silicate of lime will be formed, and not a tri-silicate. He does not give the results of any experiments on this point, however, and his views appear to be the result of mere conjecture. The line of investigation suggested is an interesting one, however, and the writer has included it in a series of experiments now in progress.

In regard to the "Analyzation of analyses" on page 77 and following pages, the writer is forced to own that the reasoning is too deep for him. It appears to be based on the assumption of the formation of tri-silicates of lime and alumina, etc., of definite composition, in the burning of cement. There is no evidence of the formation of such compounds, and no modern authorities, so far as the writer knows, hold any such views. The assumption that alumina can act as a base, in the presence of high proportions of lime, is contrary to all recent experience.

The balance of the book is chiefly taken up with reprints of certain long papers, (generally especially favorable to natural cements) on cement testing, with illustrated descriptions of an advertising character of certain American cement factories. This portion of the book requires no criticism. It includes a good deal of useful information, though Mr. Cummings' comments on methods of testing, especially his condemnation of the hot test, will hardly accord with the views of well-informed manufacturers or engineers.

THE JOLIET, ILL., QUARRY TROUBLE.

The strike of the quarry hands at the Joliet limestone regions for an increase of wages, develops a sad state of affairs for the future of a once great industry.

The *Joliet News*, in an interview with Geo. H. Monroe representing the largest quarry interests in that locality, says:

"This trouble with the quarriers is quite an unfortunate matter. The fact is, men are working at Davison's, Keltie's, Krakar's, and several others, at \$1.75 for ten hours, and at Porter's, Joliet Limestone, and the Western, at \$1.50 for ten hours, and that is all that these concerns can possibly afford to pay, owing to competition with cement, Cleveland sandstone, Bedford and other stone. I wish that we could pay \$2 per day. But there are good and sufficient reasons why not more than 15 cents an hour can be paid, and we would welcome an interview with the leaders of the strike and give them every

facility for finding out the facts.

"It was but a few years ago when, for instance, Western Stone Company stock sold in the market at 128 (it cost the original owners \$100 per share of \$100) and the stockholders were getting 10 per cent. dividends. To-day the same stock will not sell at more than 35 to 40 cents, and the companies are not earning any dividends. It is a question of competition with cement and other kinds of stone which causes the trouble. First comes the cement problem. The Rock Island and other railroads are largely using cement. They not only put in culverts and bridge piers of cement, but they lay copings for buildings and use it wherever it can possibly be made to stand. It requires very little skilled labor to utilize it. Most of the men who handle sand to mix the mortar get \$1.25 per day.

"The Cleveland sandstone is another factor. Now the specifications for curbing in nearly all the streets of Chicago call for that kind of stone. It comes out of the quarries soft and can be sawed very easily indeed. Bedford stone is called for in the more ornamental parts of buildings. Even this is much easier to work than Joliet limestone. While an inch is being sawed of the latter, two inches can be sawed through Bedford stone.

"The price of stone products has declined in proportion to the increased demand for the products of our three great elements of competition. We can afford to continue running the quarry at \$1.50 per day of ten hours, but if the change is made to eight for the same money, our competitors in cement and other kinds of stone will get the business. We have a large contract with the Pennsylvania Central Railway Company for furnishing stone for part of the work in track elevation in Chicago. The superintendent informs us that the moment we fail to ship our stone promptly they will put the cement in its place."

AMERICAN SECTION OF THE INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS.

A meeting of the American Section of the International Association for Testing Materials was held at the Engineers Club, Philadelphia, Thursday evening, June 16th, 1898.

Mr. Gus C. Henning, as member of the International Council, called the meeting to order, and after briefly stating the object of the meeting, gave a resume of the work of the International Convention at Stockholm, August 23d, 24th and 25th, 1897, and also of the council appointed

by this convention. The American section was then formally organized with the election of the following officers:

President, Prof. Mansfield Merri-man, Lehigh University, Bethlehem, Penna.; Vice-President, Prof. Henry M. Howe, Columbia College, New York; Secretary, Richard L. Humphrey, in charge of Testing Laboratory; Treasurer, Paul Kreutzpointer, Testing Dept., Penna. Railroad, Altoona, Penna.; Confidential Advisors, Prof. Henry M. Howe, Columbia College, New York; Dr. R. G. G. Moldenke, Consulting Engineer, Pittsburg.

The work of the International Association and of the American Section in particular was discussed, and also the work of the various international committees. It was decided to hold the next meeting of the American section during the last part of August, the time and place to be fixed by the officers of the section.

At this meeting the section will adopt a constitution and by-laws and will elect members to represent the section on various international committees to which have been assigned the work of studying the various problems submitted at the Stockholm meeting, and who will report at the next convention, to be held at Paris in 1900.

THE DIAMOND PORTLAND CEMENT COMPANY.

The new works of the Diamond Portland Cement Company are located at Middle Branch, Ohio, practically the site of the old mill destroyed by fire last year. The new plant has a capacity of 750 bbls. per day. The illustration gives a good idea of size, extent and arrangement of the plant, which will be operated after the most modern German method, producing strictly high grade

Portland cement. The raw materials are ground separately to an impalpable powder. An average of each sample is taken for analysis, and from these analyses the correct proportion of each raw material in compounding the cement material in order to obtain the best results. These quantities are accurately calculated and weighed out, and mixed together by a positive process, giving a resultant compound perfectly homogeneous in its chemical and physical properties.

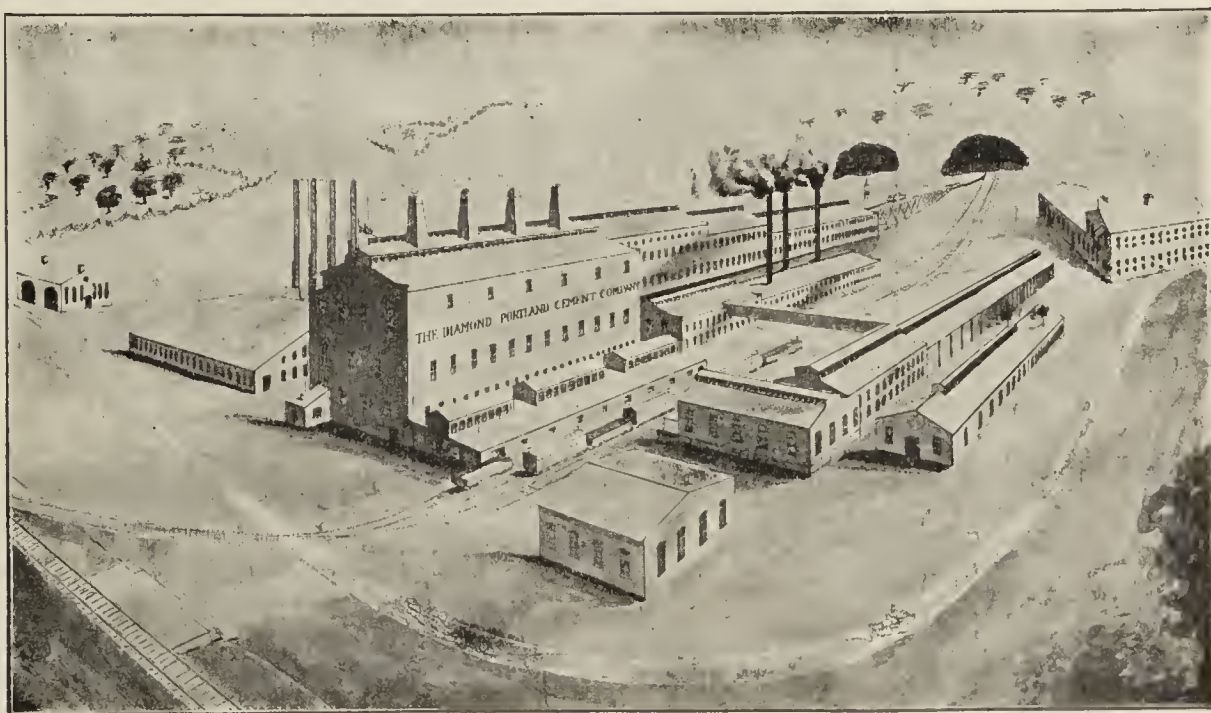
The raw cement compound is then molded into bricks, dried, and then burned in the "Dietzsch Etage Ovens," which have proven to be one of the most perfect kilns extant for Portland cement manufacture, and is used to a greater extent than any other kiln in Europe. These kilns will be under the direct charge of burners who have successfully operated similar kilns in the largest cement mills in Germany and are therefore perfectly familiar with the technic of producing the finest clinker. The clinker from these great kilns, after being carefully sorted, piece, by piece, goes to the crushing and grinding machinery, the clinker exhibiting just the proper degree of vitrification only being used to ensure the highest grade of Portland cement.

The value of a cement to the consumer depends directly upon the fineness of grinding.

The following table shows the fineness of Diamond Portland Cement:

Residue on 200 wire screen,	24	per cent
" " 100 " " "	5	" "
" " 74 " " "	1	" "
" " 50 " " "	0	" "

Each day's production of finished cement is received in a bin by itself, and there held until it can be thoroughly examined in the company's laboratory as to its composition and physical character, and is not shipped until the company's experts pro-



THE DIAMOND PORTLAND CEMENT COMPANY'S WORKS, MIDDLE BRANCH, O.

nounce it to be in every respect faultless. Thus through each and every stage of manufacture suitable guards and checks are instituted to preserve the purity and uniformity of the product, nothing being left to chance or uncertainty in its production.

The following is a fair average analysis of Diamond Portland cement, showing its chemical composition:

Lime.....	63.10	per ct.
Silica.....	22.31	"
Alumina.....	6.97	"
Iron Oxide.....	4.28	"
Potash and Soda.....	1.31	"
Magnesia.....	.38	"
Sulphuric Acid.....	.84	"
Carbonic Acid.....	.66	"
Phosphoric Acid.....	Traces	
Titanic Acid.....	Traces	

It will be seen that the materials from which this cement is made is practically free from magnesia and sulphate of lime, consequently avoiding the dangerous properties of blowing and cracking which these ingredients impart.

With the new and modern equipment of its plant and the careful and exacting supervision over every detail of manufacture, the Diamond Portland Cement Co. will again cultivate a large share of patronage with a high grade Portland cement suitable for all purposes.

The officers of the company are Z. W. Davis, president; F. L. Alcott, vice-president; W. H. Boardman, treasurer; L. A. Reed, secretary; J. F. Clark, superintendent; H. D. Raff, chemist. The general offices of the company are located at Perkins avenue and C. & P. Ry., Cleveland, O., works at Middle Branch, O.

THE DISTINCTION BETWEEN SLAG AND PORTLAND CEMENTS.

It is a somewhat surprising feature of the cement trade in the United States just at present that dealers in the puzzuolana or slag cements manufactured here, instead of placing them on the market as such, like the merchants of Europe, are endeavoring to sell them as Portland cements. Portland cement is a term which has acquired a definite meaning and a slag cement does not fall under it unless it is distorted. An attempt to sell slag cement as Portland is bound to result injuriously to the former material for two reasons. The first is that the average purchaser of a cement sold him as a Portland will be uneasy when he learns, as he certainly will, the material is really a slag cement; while the second is that the manufacturers of slag cement will find that the good qualities their article develops in service will not be attributed to their product solely, but rather to

Portland cement in general; in other words, they are depriving themselves largely of the prestige won by their special grade of cement. As the distinction between the two materials is an important one, "The Engineering Record" prints herewith an article on the subject by an experienced manufacturer of cement.

The manufacture of slag cement is beginning in this country, and while the industry in Germany and Europe has almost ceased to exist, the material is coming into use on work here*. In a recent award of a large contract the question came up as to whether, under a specification calling for Portland cement, a slag cement could be delivered. The cement in question is admittedly made of a mechanical combination of slag and slaked lime; therefore it is claimed not to be a Portland cement, answering the requirements of specifications and the well known definition of Portland cement current in scientific literature and also among cement dealers and manufacturers. In connection with the protest filed against the use of slag cement under the name of Portland cement, it is proper to call attention to the several differences between slag and Portland cements, and the definitions of the authorities on the two materials.

In a work published by direction of Gen. Wm. P. Craighill, late Chief of Engineers, U. S. A., Washington, Government Printing Office, in 1896, giving the results of congresses held at Munich, Dresden, Berlin and Vienna for the purpose of adopting uniform methods for testing construction materials, which conventions were attended by representatives of the leading governments of Europe and America, on page 38, under the head of nomenclature, are found definitions of six hydraulic binding materials. In paragraph 3, Portland cements are defined to be "products obtained from the calcination up to the verge of vitrefaction of natural marl, or of artificial mixtures of substances containing clay and lime. They are reduced to powder and contain at least one-seventh by weight of lime for one part of the material which gives to the lime its hydraulic property. To regulate certain properties of technical importance, there may be added foreign material up to 2 per cent of the weight without this addition necessitating any change of name." Under paragraph 4, hydraulic admixtures are defined to be "natural or artificial materials which generally do not harden under water when alone, but only when mixed with caustic limes.

*It is the belief of "The Engineering Record" that the fact German manufacturers have been unsuccessful in making slag cement is no proof American technologists will fail in such an industry.

Such are puzzuolana, "Santorin earth, trass obtained from certain volcanic tufa, furnace slag, burnt clay;" and in paragraph 5, "Puzzuolana cements are products obtained by intimately mixing powdered hydrates of lime with hydraulic mixtures, ground to the fineness of dust."

Thus on the authority of the highest body of scientists in the world in the line of testing construction materials, and approved by the Engineering Department of the United States Government, slag cement is not a Portland cement, but is a puzzuolana cement, clearly and distinctly. This general broad distinction between slag cements and Portland cements is followed in all the specifications of the various governments of Europe. In France, under the report of the Commission des Methodes D'Essai of the materials of construction in the Department of Public Works, Paris, published in 1894, the same distinction is drawn between slag cement and Portland cement, the two ingredients being treated in separate chapters of the book, the one under the head of "Cement on page 248, et seq., and the other under the head of "Puzzuolana" on page 333, et seq. On page 254 of this work it is stated: "The specific gravity of different kinds of cement present sufficient differences to be clearly noted. One could not confound, for instance, a Portland cement of which the density should oscillate about 3.10 with a slag cement of which the specific gravity cannot exceed 2.85."

On page 332, after speaking of natural puzzuolana, it states that as to "artificial puzzuolanas outside of the materials which, like the slags, enter into the composition of the products sold, and tested consequently under the denominations of cement, they present no serious interest to the constructor."

The leading authority on slag cement in the world, Professor Tetmajer, in his works published in Zurich in 1893, is clear in the distinctions he draws between it and Portland cement, for after defining Portland cement, as shown above in the Convention of the Congress of Tests of which he is President, he states that "puzzolona cements are products which are obtained by the intimate mixture of slaked lime in powder with hydraulic materials finely pulverized," and refers especially to the slag cement as a species of puzzuolana cement under which he definitely classes it. The same definition and distinction is made in the English works written by Redgrave, London, 1895, and in Redgrave's paper before the Institution of Civil

PORTLAND CEMENT

Is a mechanical admixture of argillaceous and calcareous substances ground together to great fineness, made into brick or other forms and subsequently chemically acted upon by the fire of the kiln in its burning to incipient vitrification. The clinker thus produced is ground to impalpable powder.

The specific gravity of Portland cement is 3 to 3.10.

The chemical analysis of Portland cement runs from 58 to 63 of lime, and the lime 1.7 to the unity of the other ingredients.

Portland cement sets in one-half hour to a maximum of eight hours.

Portland cement is absolutely safe to use in air.

The sulphuric acid in Portland cement is limited to 2 per cent. and is always found as sulphate.

SLAG CEMENT

Is a mechanical mixture of slag and slacked lime, merely ground together mechanically to impalpable powder.

The specific gravity of slag cement is from 2.7 to 2.85.

Slag cement, according to Redgrave's paper, Institution of Civil Engineers, page 7, runs 46 in lime. Other analyses in the books of Candlot, Tetmajer, Schoch and others, show similar discrepancies in analysis between slag and Portland cement, and the relative shortage of lime in the slag cement.

Slag cement, according to Tetmajer and Candlot, takes from 3 to 10 hours, and sometimes very much longer, for the pure cement to set.

Slag cement, according to Candlot, in his reference to Tetmajer's work, and according to Tetmajer, Heath and Spaulding, will crack and have little strength in air.

The sulphuric acid in slag cements frequently runs from 3 to 4 per cent., and is often found as sulphide—a most dangerous ingredient.

Engineers, London, in 1890 and 1891, Vol. CV. So, therefore, on the broad proposition it is clearly shown that in France, England and Germany, and in the United States by the publication authorized by Gen. Craig-hill, there is a distinct and absolute difference, well recognized, between slag cement and Portland cement. The weight of authority, therefore, being as to this material difference, it is interesting to take the definition of the various specifications of the world and see what a Portland cement is and how far a slag cement falls within its lines. By the specifications of the U. S. Navy Department, Bureau of Supplies and Accounts, approved July 6th, 1896, specification for Portland cement, the specific gravity shall not be less than 3 and the material must have its final set at the end of eight hours. By all the authorities above referred to, as well as Schoch on Mortar Materials, Berlin, 1897—Candlot, Heath, Redgrave, Spaulding, Tetmajer and other writers—slag cement has a specific gravity of from 2.7 to 2.8 and attains its final set in from 12 to 24 hours. Thus under the specification of the United States, slag cement is not a Portland cement.

In the French specification of the Ponts et Chausees, Portland cement is defined to be "the product of the grinding of clinkered rock obtained by the burning to a point of softening of an intimate mixture of carbonate of lime and argillaceous matter rigorously combined and physically homogenous in all its parts."

By the standard tests accepted by the German Government in a decree of the Minister of Public Works dated July 28, 1887. Portland cement is a material resulting from the calcination, carried to the point of incipient fusion, of an intimate mixture of lime and argillaceous substances as its essential components; such calcination being followed by the grinding of the product to the fineness of flour.

In Switzerland, Portland cements are described to be the product obtained by the burning to the point of vitrification of hydraulic lime,

stones, or of mixtures of argillaceous and calcareous materials which are subsequently ground and reduced to fine powder. Portland cement in addition must contain a minimum of 1.7 parts lime to the unity of hydraulic materials.

In Austria, in the specifications of the Austrian Engineers and Architect's Association, 1890, Portland cement is defined to be "compounds of natural marls or artificial mixtures of clay and lime-bearing materials which are burned to vitrification and are subsequently ground to great fineness, and in which the calcareous material shall at least be 1.7 to the unity of the argillaceous."

In Russia, the Minister of Roads and Railways defines Portland cement to be "a product made out of natural marls or artificial mixtures of materials in which clay and carbonate of lime are contained, and which materials are subsequently burned to clinker, and are thereafter ground to the fineness of flour."

In the English specification quoted with approval on page 290 of Dr. Schoch's book, Portland cement is described to be "an intimate mixture of carbonate of lime and clay, which shall have been burned together without any foreign material, and it shall have been ground to great fineness."

In all these definitions of Portland cement, it will be noticed that running through the whole line are certain definite requirements and the best way to show the difference between Portland cement and slag cement is to place in parallel columns the principal elements of difference.

Under the facts above given and the material differences shown, it seems hardly necessary to add any further facts to prove that slag cement is not Portland cement, even though the label on the top of the barrel may say it is. The industry is a new one in this country, but is an old one in Germany, and from Consular Reports to the State Department, 1895, page 224, et seq., it will be seen from the reports of the consuls at Frankfort, Magdeburg and Dusseldorf, that the slag industry, which was successful

there in 1890 and thereabouts, has steadily dwindled away until to-day there is but a single works in existence in Germany, and Candlot, referring to this industry, states that no new works have been built in Switzerland, while in Belgium but one remains, and in France there are but three. It would therefore seem to remain for the slag cement manufacturers to explain why it is that if slag cement is as good as Portland cement, it is sold in this country, not as slag cement, but as Portland cement, while all imported slag cement coming here is labeled puzzolana cement.—*The Engineering Record*.

Cement material has been discovered near Mulvane, Kas., and there is some effort being made to erect works to work the deposit.

The Thomas Millan & Co. Portland Cement works of Wayland, N. Y., is now undergoing extensive enlargement to meet the increased demand for its product.

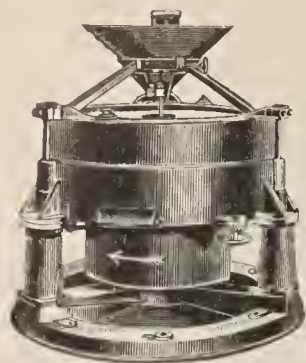
ON SALE.—"The Hydraulic Index of the Chatelier Formulas," by S. B. Newberry; and "The Commercial Analysis of Portland Cement," by W. B. Newberry; under one cover. Ready July 10, '98. By mail 25 cents. Address, Cement and Engineering News, 161 La Salle Street, Chicago.

"TO QUARRY MEN AND MINERS—Convert your quarry or mine waste by Hendrickson's method, a commercial product, at low cost, without chemicals. Address "Seaman," 1178 Vanderbilt ave., N. Y."

The sidewalks in the city of Santiago are of cement, 10 to 15 ft. wide. The streets are narrow and often crooked, and always out of repair. All house refuse is thrown directly into the street from the front door. The buzzards are the only scavengers under Spanish rule.

The enlargement of the Vulcanite Portland Cement Co. at Vulcanite Station, N. J., on the New Jersey Central Railway, will consist of six buildings, from one to four stories high. The largest building will be 80 by 600 ft. The contract for the buildings above has been let for \$100,000. Griffin mills and rotary kilns will be installed.

Messrs. Lathbury & Spackman have been retained as engineers for the new Portland cement plant of the Lawrence Cement Co., which will be erected at Siegfried, Pa., and will have a capacity of about 2,000 bbls. per day. Messrs. Lathbury & Spackman have likewise been retained to draw plans for the new works of the Portland Cement Co. of Utah, where the rotary kiln system will be employed.



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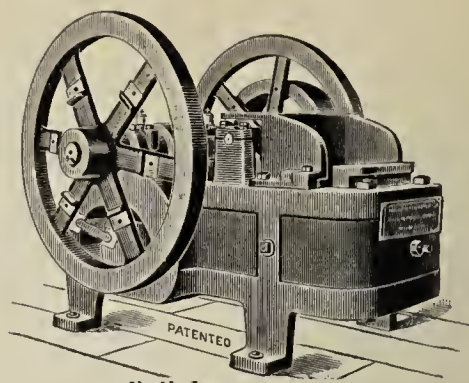
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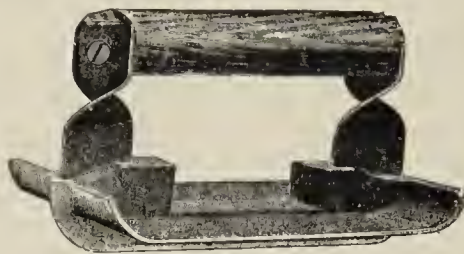


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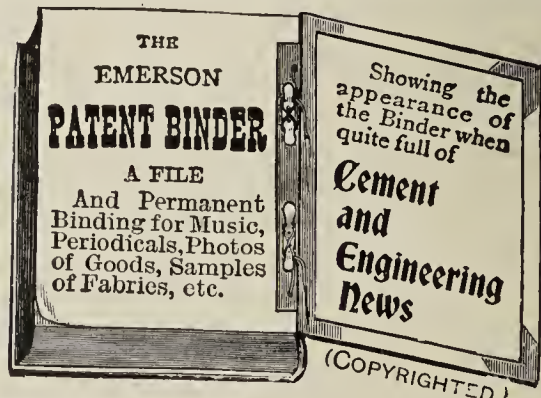
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ENGINEERING NEWS



Removing Excavated Material From the Chicago Drainage Canal and Waterway by Means of Dump Cars over Moveable Tracks.

A NEW FORM OF BRIDGE FLOOR AS PUT IN AT DEKALB, ILL.

The township of DeKalb resolved to pave with brick the extension west of Main street of the city of DeKalb and to replace the bridge over the Kishwaukee river which forms the western boundary of the city. Main street was paved with brick to the bridge.

In replacing this bridge it was thought best to avoid the constant repairs incidental to plank floors and as the pavement both sides of it was brick, it was decided to pave the roadway with this material, and make the sidewalks of concrete to correspond with those leading to the bridge from the city.

The roadway on the bridge was made 24 ft. wide and eight-foot sidewalks were placed outside of the trusses on each side. A riveted steel bridge was erected on stone abutments. The bridge trusses of the

the roadway and four sections for the sidewalk. The sidewalks were made of the same material and by the same methods as the roadway except that they were levelled off one and one-half inches above the beams and a top one-half inch thick of mortar spread over the concrete as soon as possible after the concrete was in place and before it began to set. The top was spread on with a straight edge, floated and finished with a brush so as to leave its surface just rough enough to make a good foothold and present a true surface having a very neat appearance. Fig. 2 shows a section of the finished floor after all centers and woodwork was removed.

The specifications for the concrete were as follows:

Floors—Between the longitudinal steel beams concrete arches will be used to carry the pavement and walk; the arches to have a rise in inches of

ing to be cut down to the iron so as to leave each block entirely separated.

Painting Beams, Etc.—All floor beams, stringers, rods, nuts, rivets and other metal work which is to come in contact with concrete work to have two coats of paint before the concrete is placed.

Curb, Gutter and Sidewalks—To be finished on all visible parts with a coating of cement plaster at least one-half inch thick, plaster to be applied as soon as the ramming is finished.

Plaster—The plaster to be composed of one part by measure of Portland cement of the quality specified herein and one and one-half parts by measure of washed torpedo sand or crushed granite of a quality approved by the engineer, the measurements of the proportional parts to be made in measuring boxes and made exact. The sand and cement to be mixed dry by turning with shovels or hoes and then the mixture to be cast through a wire screen before wetting. Water in a proper quantity shall be added and thoroughly mixed with the sand and cement in such quantities only as are needed for immediate use.

Troweling—The surfaces are to be struck true to plans and details troweled smooth and finished with a brush, care being taken not to trowel too much and exhaust the surface.

Color—The cement used for the surface to be such as to give a white or light gray color which shall be uniform throughout. Any block in either the sidewalks or curb and gutter showing blotches, or shades different from other blocks will be condemned and must be taken out and replaced by the contractor.

Concrete—All concrete used on this work shall be composed of one part of Portland cement of the quality specified herein, three parts of washed sand and five parts of crushed stone or washed gravel, all proportions to be accurately measured.

Crushed Stone or Gravel—The crushed stone used in this work shall be the product of a stone crusher working on clean stone. All stone larger than one and one-half inches in any dimension shall be screened out, but all of the product finer than the above shall be used. If gravel is used it shall be washed gravel and shall include all sizes from coarse torpedo sand to stones whose greatest dimensions are one and one-half inches.

Portland Cement—On this work is to be first-class American or German Portland cement and must be delivered at De Kalb at least ten days before required for use on the



Concrete Floor Highway Bridge, Under Construction, DeKalb, Ill. L. B. Merriam, C. E.

new bridge were erected outside of the old bridge. This old bridge was taken down and the floor beams and stringers of the new bridge were riveted in their places, tie rods were put in between steel stringers about four feet apart and temporary wooden centers were placed below the stringers. These centers were crowned up in the center to just reach the tie rods and come just up to the flanges of the I beams, forming a foundation for an arch of four feet four inches clear span and six inches rise. On these centers and between the beams concrete was placed and thoroughly rammed and the top of the concrete was levelled off about two inches above the tops of the beams. After these arches were in place forty-eight hours the temporary wooden centers were removed and used again. Seven sections was the best days' work for

not less than the span from the center of the beams in feet. They will be at least six (6) inches thick at the crowns and be composed of concrete of the quality specified elsewhere herein.

Tie Rods—The beams carrying these arches will be tied together at intervals of not exceeding five (5) feet with steel rods not less than three-fourths ($\frac{3}{4}$) of an inch in diameter, and these rods shall have threads and square nuts at each end, but need not be upset. They will be put in place and tightened before placing the concrete. Floors to be in accordance with drawings furnished by the engineer.

Joints—On the center line of each floor beam and stringer a vertical joint will be made in the concrete work. On sidewalks and concrete curb and gutters the cement plaster-

work, so that tests can be made. As soon as the cement is delivered at DeKalb the engineer shall be notified in writing, and tests will be immediately made, and the use of cement will not be permitted until it has been tested.

Quality Tests—The cement used on this work shall be such as will satisfactorily pass the following test requirements: Cement briquettes shall have a tensile strength after setting twenty-four hours in moist air, of at least 200 pounds per square inch; after twenty-four hours in air and six days in water the tensile strength shall be at least 500 pounds per square inch. Pats shall be made on glass under the following conditions: Shall show no blowing, swelling or cracking at the edges, placed in damp air seven

was there any signs of swelling or blowing and as it was thought that the slow-setting of the cement was a valuable feature, the fact that the twenty-four hour test did not fill the specifications was not allowed to bar it out. Fig. 1 shows the bridge partly finished.

The bridge was tested with a load consisting of a traction engine weighing nine and one-half tons, drawing a road roller weighing seven and one-half tons. This test was entirely

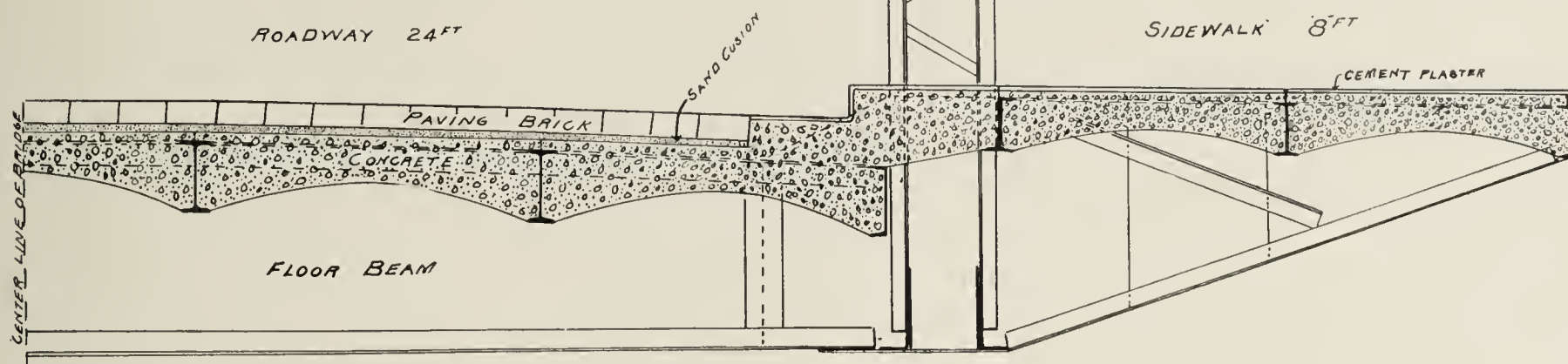


FIGURE 2

Portland Cement Concrete Floor Arches, Highway Bridge, DeKalb, Ill. L. B. Merriam, C. E.

days until set in air, and six days in water at ordinary temperature until set in air, then for ten hours in vapor water at a temperature of 100 degrees Fahrenheit.

Fineness—At least ninety per cent. by weight shall pass through a standard No. 100 sieve 10,000 holes per square inch.

Mixing—The sand and cement in the proportions above specified shall be thoroughly mixed together dry in the manner specified for cement plaster and shall be mixed with sufficient water to make a plastic mortar. The measured quantity of crushed stone or gravel shall be spread on the mixing platform and thoroughly wet. The mortar shall then be shoveled on top of the stone or gravel and the whole mass mixed by turning with shovels at least three times. It shall then be immediately placed in the work and thoroughly rammed with tooth rammers, ramming and mixing to be satisfactory to the engineer.

Centers—Accurate centers shall be placed below the stringers. Centers shall be rigidly supported and covered tight with lagging surface on its top side, the lagging shall be wet and plastered with a thin layer of mortar of the same kind as that used in mixing the concrete. Upon this coating of mortar the concrete shall be immediately placed so as to make a good bond between the mortar and the concrete. The centers shall be left in place for at least forty-eight hours after all work of placing concrete shall be finished.

Paving—After the concrete floor has been in place at least twenty-four hours one and one-half inches of clean, dry sand shall be evenly spread over that part of the roadway which is to be paved with brick. Upon this layer of sand No. 1 standard, round cornered paving brick satisfactory to the engineer, shall be set on edge, their longest dimension at right angles to the axis of the bridge. The brick to be set with close joints, the joints parallel with their longest dimensions to be straight and continuous; joints at right angles to the above to be broken as nearly as possible one-half length of the brick. After the brick are placed they shall be thoroughly rammed with a heavy rammer striking on a plank and finished to a true surface satisfactory to the engineer. The joints between the brick and between the brick and the curb shall then be filled with hot paving pitch carefully poured into the joints care being taken not to daub the brick or concrete work. All pitch must be cleaned from the concrete work.

The contractor furnished Vulcanite cement which was fully tested in accordance with the above specifications and was found to fill the specifications except in the short time test. At the end of twenty-four hours the briquettes were found to average only 175 pounds. The seven-day test gave results above those called for in the specifications. The hot test on the pats were continued for a week and at a temperature of 200 degrees Fahrenheit. In no case

satisfactory and, to make it more so, while these loads were standing on the bridge waiting for a photographer a load of curb stone for the paving beyond the bridge came by. The stone was computed to weigh five tons. While getting the traction engine to one side in order to take the photograph the drive wheels with their calks traveled on the edge of the concrete gutter giving it quite a severe test, which it stood perfectly.

The specifications given above have been successfully used for the construction of sidewalks in smaller cities and if faithfully carried out with good materials will make walks which will last until worn out by traffic.

L. B. MERRIAM,
Chief Engineer, DeKalb, Ill.

DEKALB, ILLINOIS, July 28, 1898.
GARDEN CITY SAND CO., 1203 Security Bldg.,
Chicago, Ill.

Gentlemen: The Vulcanite Portland cement furnished by you for the floors and sidewalks of the bridge over the Kishwaukee river at DeKalb was thoroughly tested before it was used and gave entire satisfaction.

The bridge has been open to the public for six weeks and the more it is used and tested the better we are pleased with the cement work.

Yours truly,
L. B. MERRIAM,
Chief Engineer.

"TO QUARRY MEN AND MINERS—Convert your quarry or mine waste by Hendrickson's method, a commercial product, at low cost, without chemicals. Address "Seaman," 1178 Vanderbilt ave., N. Y."

ALLOWABLE MAGNESIA IN PORTLAND CEMENT.

By IRVING A. BAUGHMAN, Ph. D., D. Sc.
From *Municipal Engineering*.

Below is given a review of investigations and discussions of the question of magnesia in Portland cement, since 1891, looking to the maximum percentage permissible without endangering the quality of the cement:

1891.

Proceedings Association of German Cement Makers, February 27, 28, 1891.

Dyckerhoff, Schott and Arendt report the work on the influence of the presence of magnesia in cement on the lines laid down by the commission the previous year.

Dyckerhoff made experiments with cement containing 1, 3, 4, 5, 6 and 8 per cent. magnesia and reports that those containing over 4 per cent. showed expansion after one year, and with over 5 per cent. the tensile strength decreased after the same time.

Schott and Arendt did not share in this view. Arendt stated that cements containing as much as 7.15 per cent. magnesia expanded no more than normal cements.

Schott pointed out that the raw materials used by Dyckerhoff had been passed through a sieve of 900 m. per sq. cm., whereas 1,600 was recommended by the commission and so used by the other members. This explained some of the failures of cements high in magnesia. He further contended that the cement used in the law courts at Cassel, the failure of which was the resurrection of the magnesia question, was not Portland cement, not even a magnesia Portland cement. The grinding was very imperfect, pieces of limestone as large as peas being scattered through the mass.

The result of the discussion as regards magnesia was that 3.5 per cent. was harmless, but no ruling was made as to what amount in excess of this was injurious.

Dyckerhoff* continued the investigation on cements of the following composition:

	1	2	3	4	5
Insol residue	0.7	0.47	0.79	1.14	1.41
FeO ₂ -AlO ₂	10.74	10.25	10.34	9.37	8.67
CaO	62.50	59.12	55.44	50.56	47.28
MgO	1.93	6.23	11.36	17.80	21.14
Loss on ignition ..	0.8	1.24	1.11	1.16	1.50
SiO ₂	21.46	20.48	19.42	18.31	18.71
Sp. Gr.	3.159	3.169	3.219	3.251	3.251

The increase in tensile strength was practically the same for samples containing 1.93 and 6.23 per cent. magnesia. After one year there was a slight retrogression of the sample containing 6.23 per cent.

In expansion the sample containing 6.23 per cent. magnesia was

nearly parallel with that of normal cement.

For the samples containing over 6.23 per cent. magnesia the expansion appears to be very rapid and continuous.

These tests were all made neat and of course give no expression of what would take place when mixed with a large quantity of neutral material.

1892.

Proceedings Association of German Cement Makers, February, 26, 27, 1892.

The work of the commission was based on cements containing 4.5 and 6.5 per cent. magnesia, but the board reported that it would be necessary to continue the work in order to ascertain whether they showed a retrograde tendency in the course of time. The question of permissible limits of magnesia was not decided and was referred back to the committee.

Carey* says, "Summing up the facts of which indisputable evidence has been produced, it may be stated that an excess of caustic lime or magnesia causes first, disintegration by expansion due to hydration, and second, being soluble, when conditions permit of their washing out, leave the concrete in a honey-combed state."

Dr. Michaelis† recommended that a cement containing over five per cent. magnesia should be avoided, but subsequently stated‡ that magnesia was practically only an adulterant and in its presence a correspondingly increased percentage of lime should have been added to the raw material in the manufacture. He does not consider it proven that a cement with five per cent. or more magnesia should on that account be rejected. Cement tests in which magnesia was present to the extent of twenty per cent. were under his observation for ten years and showed no signs of flaw. Tests made by him of correctly composed and properly burned cement containing eighteen to twenty per cent. magnesia have shown no greater expansion than normal cements.

Faija* considers that magnesia causes the lime in the cement to combine with the silica and alumina at a lower temperature, leaving the magnesia in a caustic state, which expanded on hydration. He thought that three per cent. was maximum for safety, though he had made cements with five per cent. magnesia which was perfectly good.

1893.

Annual Meeting Association German Cement Makers.

Dyckerhoff, Schott and Schifner

* Ins. Civ. Eng., Eng. 107, 1891-92.
† Das Wesen und der Erhartungs, Process dess Port Cementes.
‡ Wochenblatt for Baukunde.

* Inst. Civ. Eng., 107, 117.

again continue the investigation on magnesia. The result of the unfinished work on that subject referred back to this committee in 1892 was now reported. Dyckerhoff made some further experiments on samples in which lime was replaced by magnesia as high as 17.8 per cent. magnesia, in which the co-efficient of silica to lime was 1, 2.0, 1.8, 1.6 and 1.2. The three first represented by the co-efficients 1:2.0, 1:1.8 and 1:1.6 expanded so rapidly that after four to five years broke up completely, the fourth with co-efficient 1:1.2 after three years had a tensile strength of 16.6 kilograms, at four years 14.1 kilograms.

The samples affording 6.23 and 11.36 per cent. magnesia gave the following tensile strength:

P. C. MgO.	1 week.	4 weeks.	13 weeks.
6.23	9.4	17.6	22.0
11.36	3.3	6.9	14.2
26 weeks.	1 year.	2 years.	3 years.
23.4	21.4	17.7	18.7
16.2	14.5	13.0	10.5

Weights given in kilograms.

Schott and Schifner's investigations do not agree with those of Dyckerhoff, but have been carried on for a shorter period of time; still for the same time their figures are not all concordant.

In the discussion of this subject Dyckerhoff states that 3 to 3.5 per cent. magnesia is not injurious. Schott maintains that 5 per cent. is positively not detrimental.

The meeting adjourned with the following ruling on magnesia in cement:

* The Magnesia Commission finds after a two years' test that a magnesia content of 5 per cent. in burnt cement is harmless.

Erdmenger† investigated this subject in great detail and shows that a high percentage of magnesia behaves badly, but the author says it cannot be stated that 4 per cent. is the maximum permissible. ("Es kann aber nicht gesagt werden, dass diese *Schadlichkeitsgrenze* by etwa 4 pro. C. liegt.") He starts with a composition of the basic co-efficient

$$1.85 \left\{ \frac{\text{CaO MgO}}{\text{SiO}_2 \text{ RO}} \right\} \text{increasing the percentage of MgO from 0.8 to 23.3.}$$

The cements tested had the following compositions:

No. 1.	4	7	10	13
63.5 CaO	61.4	60.0	57.0	52.0
.8 MgO	4.6	6.4	11.5	19.2
23.1 SiO ₂	22.4	22.0	20.8	19.0
10.1 RO ₂	9.6	9.2	8.7	8.0

bas. Co-eff. $\frac{\text{CaO}}{\text{Acid}}$ 1.91 1.92 1.95 1.93 1.92

bas. Co-eff. $\frac{\text{CaO} \times \text{MgO}}{\text{Acid}}$ 1.94 2.06 2.13 2.32 2.64

(To be continued.)

* Thon. Zeit., 14, 452.

CEMENT AND ENGINEERING NEWS.

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"This world belongs to the energetic."

Chicago, August, 1898.

CORRESPONDENCE.

We solicit correspondence on all matters of general interest to the cement trade in all of its branches. Engineering notes, public improvements, and facts and opinions drawn from practical experience will be welcome.

CONDITIONS OF THE AMERICAN CEMENT INDUSTRY.

Surface indications seem to point to an extraordinary degree of prosperity in the manufacture of Portland cement in the United States. The output is large and constantly on the increase, with a demand far in excess of the supply. In the face of these conditions it seems strange to assert that many of the mills are not making more than expenses, while others have not yet reached that point, while those now in a prosperous condition have worked their way up through innumerable difficulties and obstacles to reach a paying basis, or availed themselves of the experience of others who have passed through the trials and tribulations incident to the development of a new plant.

The new capital now seeking investment in the manufacture of Portland cement should be cautious before embarking in the trade in which there are innumerable pitfalls and obstacles, and which can only be overcome by liberal expenditures of money, not considered in the original project. An industry in which success can only be obtained by pursuing exact business methods united with the highest technical skill of the trained expert familiar with every step and detail of manufacture. The plain

truth is that millions of dollars have been lost in the attempt to manufacture Portland cement in the United States and much capital will continue to be lost in this enterprise in the future through the ill-advised schemes of smooth, oily promoters, who are usually without experience or technical knowledge, yet are willing to pilot capital through smooth and easy stages to complete and final success in the manufacture of Portland cement.

The experienced manufacturer and expert are by far safer guides and should be consulted in every instance before an enterprise is floated. The trained experts, capable of producing high grade Portland cement are few in the United States and are not to be picked up every day in the year to contract new alliances at the call and beck of capital. Even the best trained manufacturing expert, when transferred to a new field of usefulness, is not usually a complete success in the earlier stages of manufacture, since new conditions confront him, which must be met and overcome with patience and perseverance and with money to burn for a year before success is assured.

CONCRETE RAILWAY FENCE POSTS.

Concrete posts for right-of-way fences are attracting considerable attention among railway engineers. The posts are rectangular in section,

slightly tapering from the base toward the top. Experiments have shown that the best concrete for this work consists of one part of the best Portland cement to three parts of clean, sharp sand, and sometimes the proportion is made as low as two and one-quarter to nine. One barrel of this cement will make from eighteen to twenty posts of a size suitable for railroad fences. The posts are cast in wooden molds, through which No. 10 two-wire cables under tension are run from top to bottom, the cables becoming embedded in the concrete.

Four cables are used with the line posts, one near each corner, while eight cables are used in corner and gate posts. The cables hold the parts together should the posts be broken. Concrete line posts cost from 15 to 17 cents each, and corner posts about 54 cents each. A railway engineer who has carefully considered the use of concrete posts is of the opinion that when made with care and of good material their life might be twenty-five years, or even more, as they are not subject to decay, are not injured by fire and will not rust.

Mr. Cook of San Maria, Cal., has rediscovered a large natural cement deposit above Zaca Lake. The deposit was undoubtedly the source of supply for the old mission padres. There is enough of the material in sight to run six kilns over a hundred years. The discoverer is willing to believe and asserts that the material is equal to the best Portland cement. This statement usually attends most of the discoveries made by amateurs.

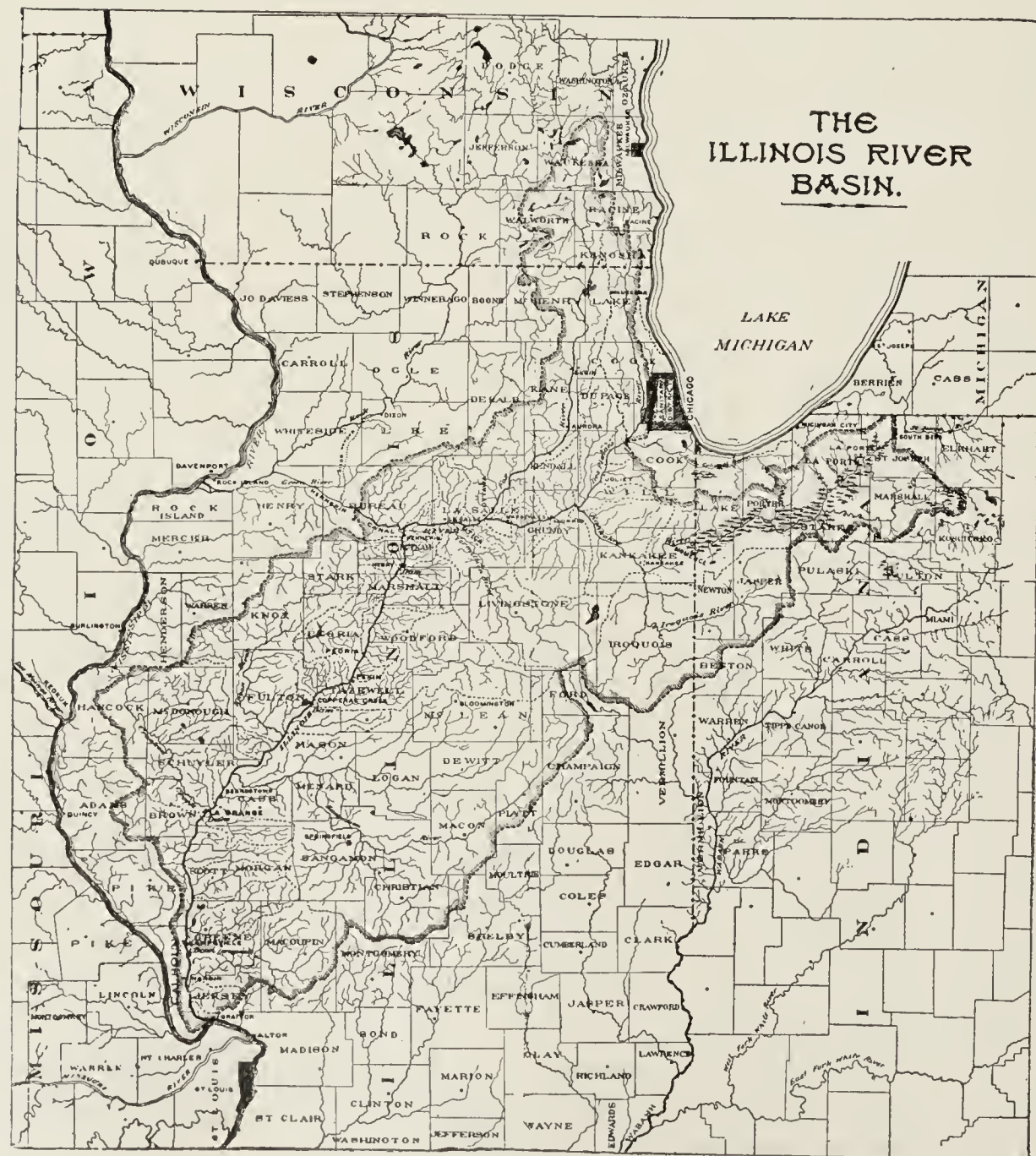
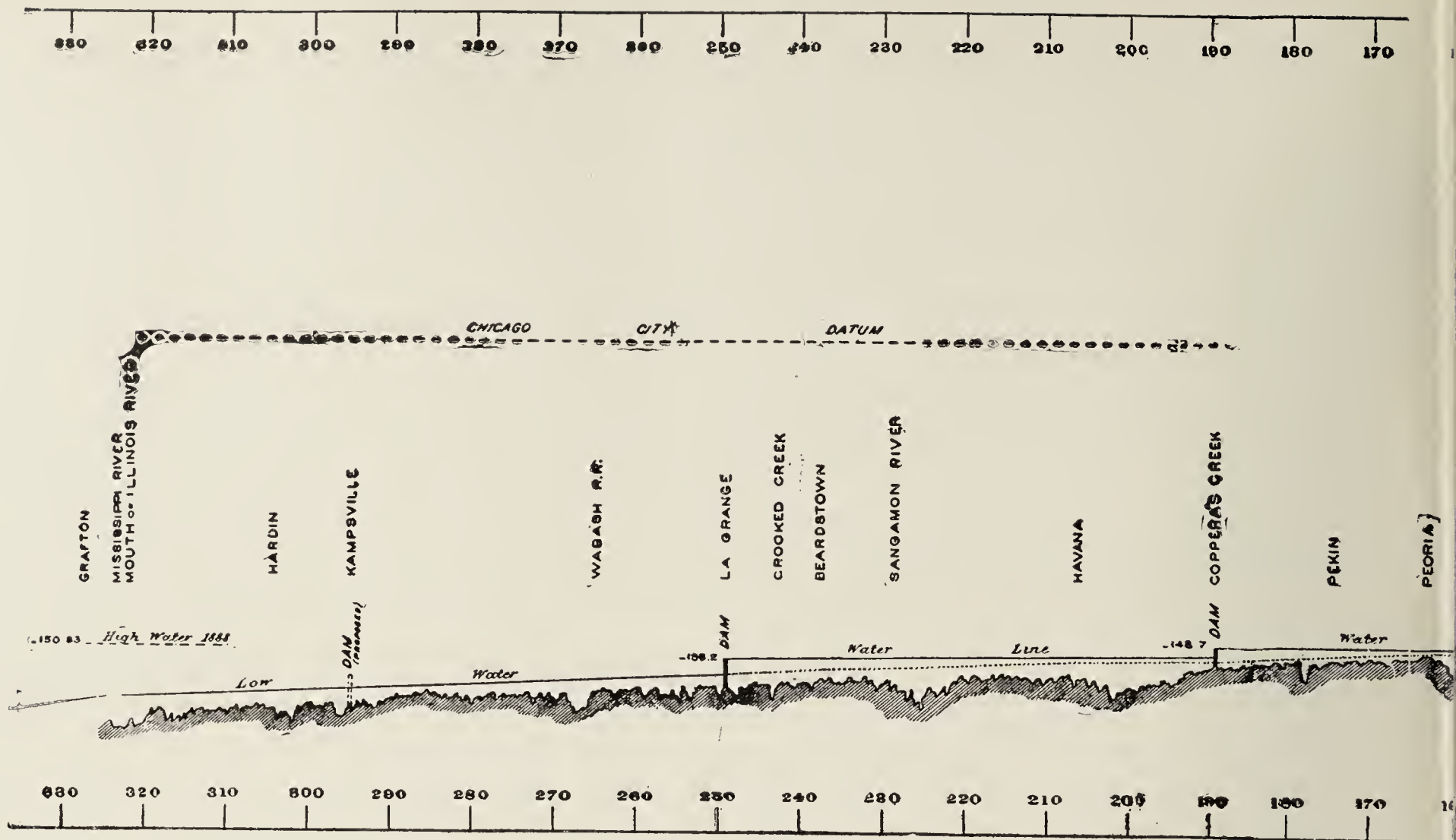
The Utica Hydraulic Cement Co. of Utica, N. Y., has increased the pay of its laborers ten cents per day.

IMPORTS OF CEMENT INTO THE UNITED STATES.

WHERE FROM.	JUNE.				TWELVE MONTHS ENDING JUNE.			
	1897.		1898.		1897.		1898.	
	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.
United Kingdom....	9,858,422	31,138	2,332,400	7,691	184,237,053	596,195	113,733,295	379,759
Belgium.....	24,328,111	72,406	24,706,727	70,155	258,312,102	749,174	240,127,308	716,440
France.....	1,005,262	2,838	594,900	2,396	12,849,762	37,467	13,060,916	39,072
Germany.....	54,698,134	177,999	31,578,637	103,114	464,362,050	1,517,232	407,467,520	1,366,209
All Other Europe...	2,485,759	8,435	912,662	3,071	15,788,463	56,956	21,093,145	66,405
British North Am....	452,625	2,130	205,925	933	2,749,425	11,454	2,170,799	10,330
Other Countries.....	.....	.....	.....	.....	802,011	3,872	5,200	67
TOTAL.....	92,828,313	294,946	60,321,251	187,360	939,100,866	2,972,350	797,658,183	2,578,282
Domestic Exports of Cements, bbls.	7,583	14,005	2,306	4,277	38,490	71,160	48,836	86,208

There were 3,397,038 lbs. of imported Roman and Portland cements, etc., in the United States bonded warehouses on June 30, 1898, valued at \$9,472, against 7,714,245 lbs., valued at \$20,497, in June, 1897.

Imports of asphaltum or bitumen for June, 1897, were 21,312 tons valued at \$66,823; June, 1898—9,451 tons valued at \$30,828. For twelve months ending June, 1898, 91,500 tons valued at \$294,922; for twelve months ending June, 1897—122,122 tons valued at \$395,554.



TERRITORY DRAINED BY THE ILLINOIS RIVER.

PROFILE OF THE

Along the route to be utilized by the flow of the Chicago river, which n Desplaines river and thence into the gan, at Chicago, to the Mississippi riv

The Main Drainage Channel of the confluence with the south branch of t its southern terminus, in Will county are located. Beyond these works, t sary for conducting the flow from the the declivity to and through the city Canal as the new conditions developed

At the head of this river diversion to allow surplus water to flow toward carrying the entire flood waters of the with cut stone, and its wings faced wi Chicago datum (this datum is referred level at Sandy Hook). No water flow it reaches 300,000 cubic feet per minut

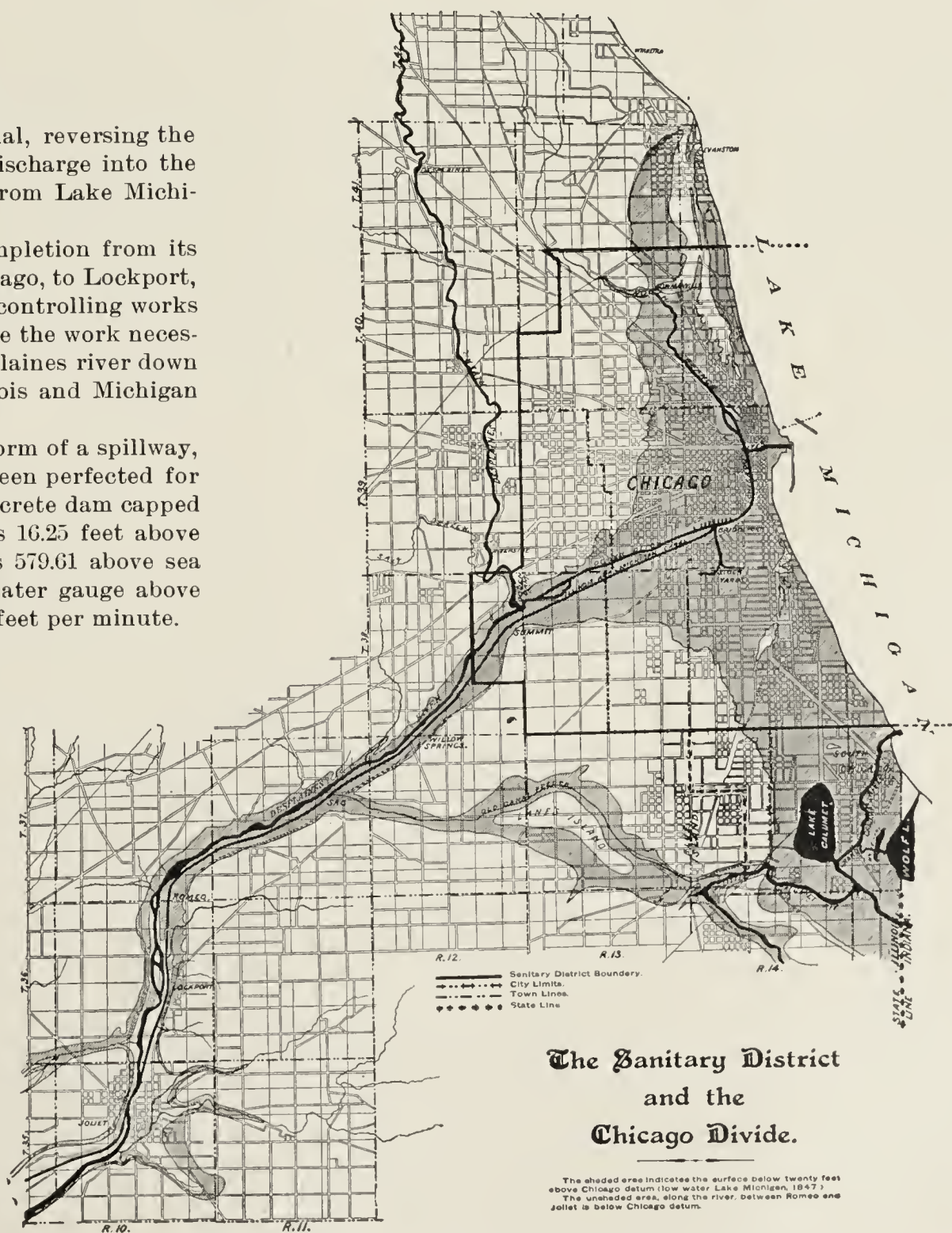


DESPLAINES AND ILLINOIS RIVER VALLEYS

Sanitary District of Chicago, for the Drainage Canal, reversing the discharges into Lake Michigan, causing it to discharge into the Illinois river to the Mississippi river, the distance from Lake Michigan over this route being 330 miles.

Sanitary District of Chicago is now nearing completion from its Chicago river at Robey street, in the city of Chicago, to Lockport, Illinois. At the southern end of the channel the controlling works construction contemplated by the District will be the work necessary in conjunction with the waters of the Desplaines river down to Joliet, and making such changes in the Illinois and Michigan

was necessary to provide a safety valve in the form of a spillway, Chicago, because arrangements have not as yet been perfected for Desplaines through Joliet. This spillway is a concrete dam capped with stone masonry; it is 397 feet long and its crest is 16.25 feet above the low water of Lake Michigan of 1847, and is 579.61 above sea level over this spillway until the volume passing the water gauge above with provision for increasing the flow to 600,000 feet per minute.



CHICAGO SANITARY DISTRICT AND DESPLAINES VALLEY.

A NEW USE OF THE WIRE CABLE.

Herewith is illustrated A. S. Hallidie's system of collecting and transporting earth and other material by means of an endless wire cable moving overhead, and driven by steam or other power. The earth gravel or tailings are scooped up by scrapers, very much in the same manner as by horses, only that, instead of horse power, steam or other power may be used and the hauling done by a steel wire rope. From the illustration it will be seen that the scrapers are guided by a man armed with a piece of gas pipe about 4 feet long, which he slips on to the projecting finger on the back end of the scraper and regulates the depth of the scoop and the place where the scooping is to be done. The scrapers are hung to clips secured to the cable, about 15 feet apart. The larger is of steel, and rigid for about half way down. The lower half is flexible, and consists of a piece of flat chain that allows the scraper to adjust itself to the work to be done, and which can

ing up before the scrapers are applied, plows are used, which, in like manner, are hauled by the cable, instead of horses. It is a very effective and economical method of handling gravel, tailings and earth, and has the advantage of being able to convey the material almost any distance, and of excavating a considerable depth and width, as the cables can be lowered as well as the hanger, and the supporting frames for the sheaves can be moved as the work advances.

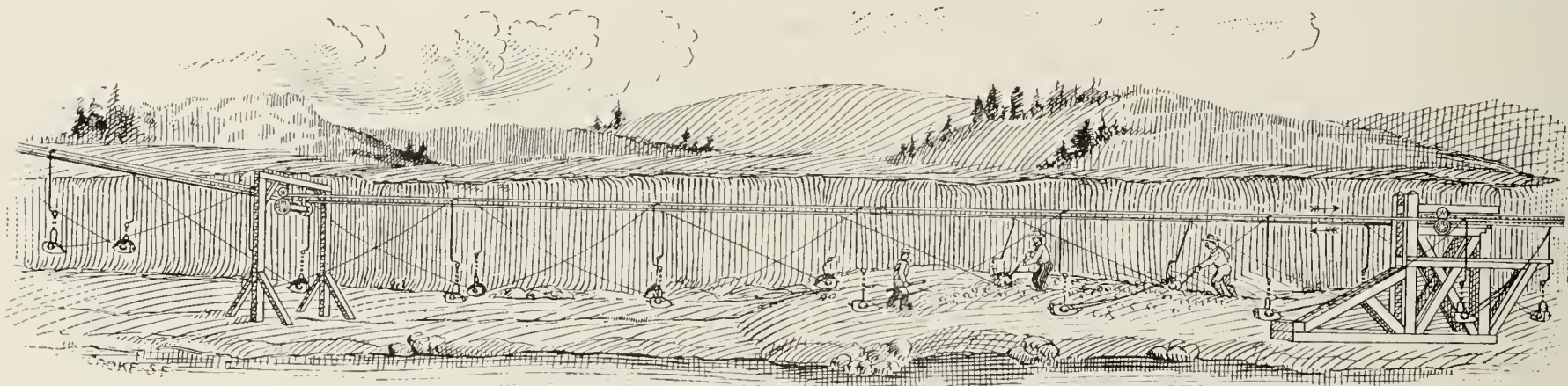
This is one of A. S. Hallidie's recent patents, date April 21st, '96, and the apparatus is worthy of the attention of those interested. A line can be seen working at the shops of the California Wire Works, where its operations will be easily understood. The office of the California Wire Works is at No. 330 Market St., corner of Battery St., San Francisco, and lines of various capacities are manufactured.—*San Francisco Mining and Scientific Press.*

Cement and Engineering News \$2 per annum.

Lehigh Portland Cement company's plant we confidently look for the output of a high-grade product under his supervision.

HOMESEEKERS' EXCURSIONS.

On August 16th, September 6th and 20th, and October 4th and 18th, 1898, the Chicago, Milwaukee & St. Paul Railway will sell round-trip excursion tickets (good for 21 days) to a great many points in South and North Dakota, and other Western and Southwestern states, at practically one fare for the round trip. Take a trip West and see what an amount of good land can be purchased for a very little money. Further information as to rates, routes, prices of farm lands, etc., may be obtained on application to any coupon ticket agent, or by addressing George H. Heafford, General Passenger Agent, Old Colony Building, Chicago.



Scraping and Carrying Earth by Use of a Wire Cable.

be raised or lowered at will. The scraper is hung on double trunnions, which permit of a free movement, but give a steady base for the scraper to hang on after it is loaded and on its way to the dumping place. The pulling of the scraper is done by steel draft ropes, which connect each scraper to the clip on the main cable 10 to 15 feet ahead, and all the scrapers are connected that way, so that there is a continuous row of them, each scraping up the earth and conveying it to its destination, which may be a mile or more away.

The cable overhead is supported on sheaves and travels at a speed of about 120 feet per minute; hence there are eight of them passing any given point in one minute, or 480 per hour, and, as they contain about 3 cubic feet each they will excavate and convey away 144 cubic feet, or 53 cubic yards per hour. The cable is driven by a grip pulley, to which power is applied. The scrapers move continuously the whole length of the line and around the end pulleys. If the ground is hard and needs break-

COMING INTO THE MARKET.

The Lehigh Portland Cement Co. of Allentown, Pa., started up its mill on August 1st, everything running very satisfactorily; the test of the cement giving very good results. The company will start shipping to the trade by September 1. The capacity is now 600 bbls. per day and additional machinery is being installed to double up the present daily capacity.

The Dickinson Cement Co. of Chicago received the first regular consignment of two carloads of the Lehigh Portland Cement company's product shipped from the mill on August 19, via rail and lake.

The Lehigh Portland Cement Co. has one of the finest equipped mills in the Lehigh cement regions and is under the management of Mr. Chas. A. Matcham, as superintendent, who formerly occupied the same position with the Alpha Portland Cement Co. Mr. Matcham is perfectly familiar with the technique of cement manufacture in the Lehigh regions, and with the excellent equipment of the

CONCRETE WORK.

Editor Cement and Engineering News:

In compliance with request will give some pointers in the construction of concrete work. Do not understand that there will be anything new or original in this article, only that which has proved to be best after many years of practical experience in making artificial stone, concrete foundations and other concrete work. In the first place be sure you have a good cement, which can be obtained from many of the manufacturers in the United States as well as the standard imported cements. Use only good clean stone. Wet the stone thoroughly for at least twenty-four hours before using so it will have time to absorb all the water it will take, then spread down enough stone for a batch and throw the required amount of cement over the stone as easily as you can and commence shoveling the stone and cement back and forth until it is thoroughly mixed, adding water with a sprinkler as required, while the mix-

ing is going on. Do not get too much water on so as to make it slushy and bear in mind you have had the stone wet long enough for it to absorb all it can take up, then throw this batch in where you want the work and tamp down with a light tamping tool that can be quickly handled. The face of this tamper should be from three to four inches in diameter and not too much of the batch thrown in at once so it can be thoroughly tamped. Enough help must be put to tamping so that it can be well done in a few minutes, then another batch mixed and put in the same way until the job is complete. Then cover the work over with something that will hold moisture and keep the concrete wet for at least eight days. Never let it suffer for want of water. If these simple instructions are followed out strictly good work will be the result. There is so much in what little has been said it might be well for the information of the inexperienced persons that may wish to know the secrets of making concrete work to take up the points in detail and give some reasons for each step. First take good, clean stone (this means clean stone of any desired size) for instance if for a heavy foundation you may lay down a layer of large stone, then fill in with crushed stone and cement, then another layer of large stone and fill in the crevices with crushed stone and cement again, or if crushed stone is used entirely it must be crushed fine enough to fill all crevices and voids solid. Nothing has been said about sand, where the sand is used in part instead of fine crushed stone it must be coarse, rough sand (not the water sand). Water sand will not bond as well with cement as the rough pit-marked sand will, or fine crushed stone. The sand should be washed clean before using. The reason for wetting down the stone and sand before using, which is a vital point, is this, if dry stone is used it will, in places throughout the work, absorb the water to such an extent that it will leave the cement too dry to set as it should. The bond will be weak in these spots. Like everything else the strength of a piece of concrete work is rated from its weakest points. Wetting down stone as described for concrete is on the same principle as trimming a window sash before glazing in the glass. If you undertake to putty glass in a sash before priming the wood will absorb the oil from the putty and the putty will peel off, but where the sash is thoroughly primed before putting in the glass the putty will stick to the wood as solid as the wood itself. Just so with stone and cement.

Then about the tamping. This is

another very particular point and will require some argument to teach the novice and it might do some of the old hands good to shake them up a little over this as well as wetting down the stone and sand before using. Many contractors use tamping tools that are too large on the face and too heavy to do good work. The small, light tamping tool will place down a batch of concrete closer than the heavy one. The light, narrow faced tamper will set down, shift around and get the pieces closer together than the broad-faced heavy tamper will. This is well illustrated by the fact that sheep will pack manure in a shed or stable much more solid than cattle or horses. The small foot with enough weight on it, used many times, will pack harder than the horse or steer, with from ten to fifteen times the weight. Too much care cannot be given to this particular part of the work.

Now about the proportions of crushed stone, sand and cement. That will have to be governed by the kind of work you are doing, it runs all the way from one part of cement to two parts of stone and sand, or if the stone is fine enough, stone alone with cement. Other work 1 part cement to 2½, 1 to 3, 1 to 4, 1 to 5, 1 to 6, 1 to 7, 1 to 8. Where very large rock is used with only enough fine material to fill in with, it takes less cement in proportion than where all crushed stone and sand are used.

J. HENDERSHOT, M. E.

AMERICAN SECTION OF THE INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS.

Secretary's Office,
Testing Laboratory, City Hall,
PHILADELPHIA, August 11, 1898.

The International Association for Testing Materials was the result of the efforts of Professors J. Bauschinger, L. v. Tetmajer, A. Martens, F. Kick and F. Hartig to devise means for promoting greater uniformity in the methods for testing materials.

In 1882 these gentlemen issued a call for a preliminary meeting to be held at Munich—at which time they organized with Prof. John Bauschinger as chairman.

Subsequent conferences were held at Dresden in 1884, Berlin in 1886, Munich in 1888, and Vienna in 1893, at which all European countries except England, France and Turkey were represented.

Conventions were held at Zurich in 1895 and Stockholm in 1897, at which England and France were also represented. At the Zurich convention in 1895 the present permanent international organization was formed.

The American Society of Mechan-

ical Engineers has been represented at these meetings since the Vienna conference in 1893. The United States government was first represented at Zurich in 1895 by an army officer, while at Stockholm it was represented by both army and navy and several American engineers.

In 1890 the French government appointed a commission to report on the "Methods for Testing the Materials of Construction." This Commission became identified with the International Association in 1895 at the Zurich convention, and has since taken very active part.

Great Britain is strongly interested and promises to take active part hereafter.

At present all European countries except Turkey are actively participating in the work of the Association.

The Association has at the present time over 1,228 members, which are distributed geographically as follows: Australia 1, Belgium 17, Chili 1, Denmark 36, Germany 392, England 24, France 54, Holland 46, Italy 34, Luxembourg 6, Norway 35, Austria-Hungary 154, Portugal 5, Roumania 17, Russia 217, Sweden 56, Switzerland 84, Servia 1, Spain 34, Japan 1, and United States 73.

Since July, 1896, the transactions of the International Association have appeared in its official organ, "*Bau-materialekunde*," in the French and German languages. Hereafter these transactions will also be printed in the journal in English.

At the last convention it was decided that in order to simplify the work of the Association, the various countries should organize national sections, and the members of council of the International Association were authorized to effect such organizations.

In accordance with this decision, Mr. Gus. C. Henning, the American member of Council of the International Association, issued a circular letter to the American members requesting them to meet at the Engineers' Club, Philadelphia, on the evening of June 16th, 1898, for the purpose of organization. About twenty members responded to the call.

The meeting was called to order by Mr. Henning, who presented his credentials showing his authority for calling the meeting. Mr. Humphrey was elected secretary *pro tem*.

Mr. Henning then outlined the work which had been accomplished since the last convention at Stockholm, and what was expected of the American members.

The American section was then organized by the election of the following officers: Prof. Mansfield Merriam, chairman; Prof. Henry M.

Howe, vice-chairman; Richard L. Humphrey, secretary; Paul Kreuzpointner, treasurer. Members of the International Advisory Council—Dr. R. G. G. Moldenke and Prof. Henry M. Howe.

It was decided that the chairman, vice-chairman, secretary and treasurer should constitute an executive committee for the transaction of all business of the American Section. The American member of Council of the International Association was made *ex-officio* a member of the executive committee.

The executive committee was instructed to draft by-laws to govern the American Section, and to call a meeting of the American Section during the latter part of August of the present year for the purpose of adopting by-laws and effecting a permanent organization.

In accordance with the instructions of this meeting, the executive committee met at the Engineers' Club, Philadelphia, on June 25th and July 30th, 1898, and drafted the proposed by-laws, which will be presented at the meeting of the American Section to be held August 27th, 1898.

The committee instructed the secretary to prepare and send to each member of the American Section, this brief history of the International Association for Testing Materials, and the report of the organization meeting held June 16th, 1898.

RICHARD L. HUMPHREY,
Secretary American Section.

The executive committee of the American Section of the International Association for Testing Materials at a meeting held at the Engineers' Club, Philadelphia, July 30th, 1898, selected Saturday, August 27th, 1898, at the Engineers' Club, 1122 Girard street, Philadelphia, as the date and place of the first annual meeting of the American Section of the International Association for Testing Materials.

The following program has been adopted for the afternoon and evening sessions:

Afternoon session, 3 p. m.—Reading minutes of meeting of June 16th, 1898; adoption of by-laws; announcement of appointments; other business. Recess.

Arrangements have been made for those present to dine at the Lafayette Hotel, Table d'Hôte, \$1.00 for each person.

Evening session, 8 p. m.—Unfinished business. Discussion—"The relation of the International Association to Producers and Consumers," to be opened by Dr. Charles B. Dudley and Mr. William R. Webster. Discussion—"In what manner will the adoption of standard specifications

improve industrial methods and processes," to be opened by Prof. Rolla C. Carpenter and Mr. Gus. C. Henning. Miscellaneous discussions.

Please notify the secretary whether you will be able to attend the meeting and if you wish to dine at the Lafayette.

RICHARD L. HUMPHREY,
Secretary American Section.

CEMENT MATERIALS IN IOWA.

Some time after the discovery of massive deposits of the cretaceous chalk in the northwestern portion of the state the question arose as to the adaptability thereof—whether this calcareous material might be considered of any practical value and if so what means should be taken to reduce it preparatory to its application. Certain initiatory steps were undertaken towards determining these points but as yet but little has been done. Chemical analyses have been made of the rock and test shafts put down in order to ascertain the thickness of the rock and test shafts put down in order to ascertain the thickness of the beds, but further development has never been attempted.

Portland cement now so extensively produced and utilized is made by the calcination of a mixture of chalk with argillaceous material. It sets more readily and its adhesive powers are stronger than natural cement. The affinity which caustic lime has for silica and alumina and the affinity of the combination for water gives rise to the hardening of the materials. The degree to which the calcining should be carried on depends upon the percentage of alkaline silicates in the calcareous body, and since these are shown by analyses to be practically absent from the Iowa chalk, a high calcination is desirable. The relative amounts of the chalk and clay in the same locality vary greatly, owing to the difference in the chemical composition of the material making up the several strata. The common ratio of chalk to clay is about three to one. A test of certain clays about Sioux City shows that a proper proportion could only be obtained through the mixing of five parts of one kind of clay or two parts of another with but a single part of chalk.

These chalks, which have been fully described by Calvin, state geologist, in various articles heretofore issued, are available in the northwestern portion of Woodbury county and in the southwestern part of Plymouth along the bluffs of the Big Sioux river. The maximum thickness of the chalk is about fifty feet and the areal extent is so great as to make it wholly inexhaustible. In speaking of these chalks and clays

Calvin makes a brief reference to the adaptability of the materials for Portland cement and there certainly seems no reason why the Iowa material might not be used with success equal to that attained at other points. The most natural combination would be the chalk with the clay immediately under it.

Away from the Sioux City region there are no other chalk beds east of the river until a point in the extreme southeastern township of Sac county, nearly east of Grant City, is reached. An exposure, several feet thick, of very clean, yellow to white chalk, has been discovered here. It is not very unlike that to the west. The associated clays are neither so readily available nor so adaptable to use in cement making. It may be that further search will reveal splendid grades of argillaceous materials at this point, and if so the manufacture of cement may be carried on here fully as successfully as at the localities already mentioned. On account of its softness the chalk is far preferable to the hydraulic limestone and the resulting cement is equally strong.

Selentic or gypseous cement is secured by substituting for the chalk in combinations much the same as those referred to; and, although no attempt has been made to utilize the massive mineral at Fort Dodge in the manufacture of cement, it would seem that it could readily be done. The available clays in this vicinity are not like those associated with the chalks, but the superior grades, such as are now being used for common pottery, are found near by. The hardening of the gypseous cements takes place principally through a combination with water rather than in the manner of ordinary hydraulic cement, where the hardening is brought about by re-crystallization of the calcium alumina and silica present.

E. H. L.

HIGH PRAISE FOR THE "CONSTITUTION OF HYDRAULIC CEMENT," BY S. B. & W. B. NEWBERRY.

"No piece of work on the chemistry of cement comparable with this by Messrs. Newberry has appeared within the last ten years, and we congratulate the authors on the sound method, well-directed industry and clear reasoning which are its characteristics."—*The Engineer*, London, Dec. 24, '97.

Copies of this work will be sent to any address on receipt of 25 cents by the CEMENT AND ENGINEERING NEWS.

An advertisement in CEMENT AND ENGINEERING NEWS brings reward.

MANAGEMENT OF QUICKSANDS IN FOUNDATIONS.

Twenty-five years ago, anticipating that I would probably have to contend with quicksand in my work, I read up on the subject everything I could find, but with very little satisfaction. In fact the theories set forth by the majority of writers on the subject were virtually of no use when I met with the actual facts in the course of my experience. I investigated the matter very thoroughly, however, finding a very essential point in the fact that in all quicksands a great variety exists in the sizes of the atoms, this variation requiring various plans to be tried to successfully contend with the difficulties that must be overcome.

I did not have long to wait before meeting with a quicksand bottom. I was then engaged on the foundations of the bridge work of the D. L. & W. Railroad, in Hoboken. In foundation east of Henderson street we had to go two feet into a bed of quicksand to get our depth. In this case it happened that I had a large bank of oyster shells in the way, which I utilized. I cribbed my sump large enough to give me plenty of room, mixed the oyster shells with gravel, and put a bed of the mixture all around the sump, shoveling the sand out of the middle and allowing the mixture to sink until I got below the required depth; the mixture closing in and making a solid bottom for sump. After this I uncovered about ten feet square section of the sand, throwing out the sand as quickly as possible with as many men as could conveniently handle a shovel. The moment the required depth was reached we covered the bottom with a foot of the gravel and shells. When this was done and walked over, it would all be in a movement, but after standing a few hours it would become perfectly solid. The cause of its becoming solid is that the larger atoms of the sand passing up through the mixture adhere to the shells, gradually closing up all the crevices. Leading drains across the foundation we successfully completed the work. After this I used crushed stone with better results than with the gravel.

Some years later when superintending the construction of a large tank—200 feet in diameter—for gas holder in Brooklyn, at thirty feet in depth—just the depth we had to go—we uncovered a quicksand bed. The contractor was very much excited, having previously lost several thousands of dollars in a similar case. I proceeded this time with crushed stone in getting my sump down, sinking a wall of broken stone all around the well hole, got our pipes

into their proper depth and made this our sump, leading box drains from this point all over the bottom, uncovering sections of ten feet square and replacing with crushed stone a foot thick, completing the whole bottom on this system with entire success.—J. B. GORDON, in *Stone*.

OWEN SOUND PORTLAND CEMENT COMPANY, LTD.

In 1888 this company was formed in Owen Sound with a capital of \$100,000. The natural deposit from which they are now making their well-known "Sampson brand" Portland cement, is situated at Shallow Lake, 9 miles west of Owen Sound, on the G. T. R. The deposit covers 500 acres, forming the bed of Shallow Lake.

The water recedes from the lake early in June, usually not rising again till late in the fall. During this dry period the company put on teams and scrapers, and take out first the marl and then the blue clay which underlies the marl. In removing the clay a steam derrick is used to elevate the clay into dump cars in which it is hauled to the works, which are located above high water mark on the shore of the lake.

The excellence of the cement made by this company is largely due to the very superior quality of the natural ingredients, which are apparently better adapted for making Portland cement than groundstone which is more commonly used.

The original works were destroyed by fire a few years ago, and have been replaced by large and more commodious buildings and modern kilns, built after the plan of those used in English factories. Every department of these new buildings was fitted with latest designs of improved machinery known in the art of cement making in England, Germany and the United States, and to which additions are being continually made, till from the very modest start made in 1888, the buildings now cover a space of over two acres and have cost the company over \$200,000.

The company have their own stave factory and cooperage plant and manufacture their own barrels at the works. An efficient chemist is continually employed, and every kiln of cement is carefully tested before leaving the works for the storage department.

The capacity of the factory has this year been increased from 130 barrels to 300 barrels per day. The company employ an average of eighty men throughout the year and have storage capacity at the works and in their warehouses at Toronto and Winnipeg for 40,000 barrels. The present demand for Sampson cement

is so great that they are quite unable to supply their customers.

Twenty-three tons of coke are consumed daily in burning the clinker preparatory to grinding into cement, and 2,000 cords of wood are annually used in making steam. The company own their own electric light plant and the works are well lighted inside and out throughout the entire year.

Since this company began operations the price of Portland cement has gradually decreased and many failures have been recorded in England and the United States as a natural consequence. The price of cement to-day is nearly fifty per cent. lower than it was ten years ago. The company state that while profits have been small—in fact, no profits at all—through unfair competition of light weight barrels, adulterated and often useless brands of cement, and public prejudice in favor of imported goods, their aim has continually been to improve their Sampson brand, until now they confidently challenge the world to produce a better cement, and hope in the near future to be able to raise the price to a more profitable figure.

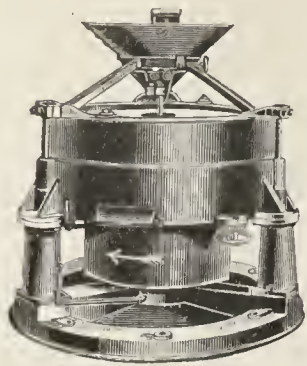
For proof of the excellent quality of the company's material we are referred to the following result of test:

Sampson Brand (Canadian)—(1) Fineness, 93 per cent. passed a 100-mesh sieve. (2) Blowing test in water at 180 degrees Fahr. for 48 hours, sound. (3) Tensile strength, 2 days, 345 lbs. per sq. inch; 7 days, 565 lbs. per sq. inch.—*The Canadian Architect and Builder*.

ON SALE.—"The Hydraulic Index of the Chatillier Formulas," by S. B. Newberry; and "The Commercial Analysis of Portland Cement," by W. B. Newberry; under one cover. Ready July 10, '98. By mail 25 cents. Address, Cement and Engineering News, 161 La Salle Street, Chicago.

The Romans were the first great concrete-builders, and some of their concrete structures have not been surpassed in magnitude to this day. They made use of it before the year 500 B. C. Vitruvius, who wrote in the first century after Christ, gives instructions for its manufacture. In his book on architecture, he describes how to make concrete pavements and floors, and concrete walls around wells. His specification for the concrete in the last instance might be substituted, without very much detriment, for the clauses in some modern specifications.

Every subscriber should have a substantial binder to preserve copies of The Cement and Engineering News. Price 85 cents, post-paid.



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Mills**

for

CEMENT

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**Fine
Crusher**

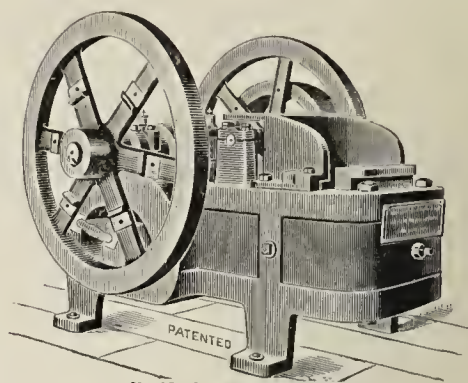
WILL FINISH
5 to 6 bbls. of Portland per hour.
20 bbls. of common cement per hour.

Reduces Portland Clinker to Gravel
and Sand at one operation.
Work of Crusher and Rolls Combined.

427 Rock Emery Mill.

STURTEVANT MILL CO.,

BOSTON, MASS.

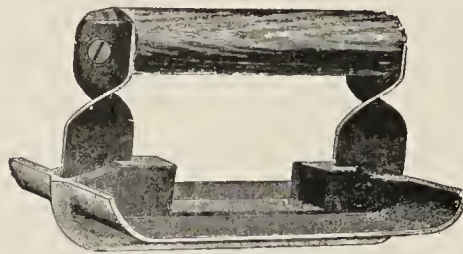


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50 State & 71 Randolph Streets, Chicago, Ill

PERSISTENT ADVERTISER.

The constant drop of water
Wears away the hardest stone;
The constant gnaw of Towser
Masticates the toughest bone;
The constant cooing lover
Carries off the blushing maid;
And the constant advertiser
Is the one who gets the trade.

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PLEASE MENTION THIS PAPER.**

LOCATIONS FOR INDUSTRIES.

The name of the Chicago, Milwaukee & St. Paul Railway has long been identified with practical measures for the general upbuilding of its territory and the promotion of its commerce, hence manufacturers have an assurance that they will find themselves at home on the Company's lines.

The Company has all its territory districted in relation to resources, adaptability and advantages for manufacturing, and seeks to secure manufacturing plants and industries where the command of raw material markets and surroundings will insure their permanent success.

Mines of coal, iron, copper, lead and zinc, forests of soft and hard wood, quarries, clays of all kinds, tanbark, flax and other raw materials exist in its territory in addition to the vast agricultural resources.

The Chicago, Milwaukee & St. Paul Railway Company owns 6,168 miles of railway, exclusive of second track, connecting track or sidings. The eight States traversed by the Company, Illinois, Wisconsin, Northern Michigan, Iowa, Missouri, Minnesota, South Dakota and North Dakota, possess, in addition to the advantages of raw material and proximity to markets, that which is the prime factor in the industrial success of a territory—a people who form one live and thriving community of business men, in whose midst it is safe and profitable to settle.

A number of new factories and industries have been induced to locate—largely through the instrumentality of this Company—at points along its lines. The central position of the States traversed by the Chicago, Milwaukee & St. Paul Railway makes it possible to command all the markets of the United States. The trend of manufacturing is westward. Confidential inquiries are treated as such. The information furnished a particular industry is reliable.

Address,

LUIS JACKSON,

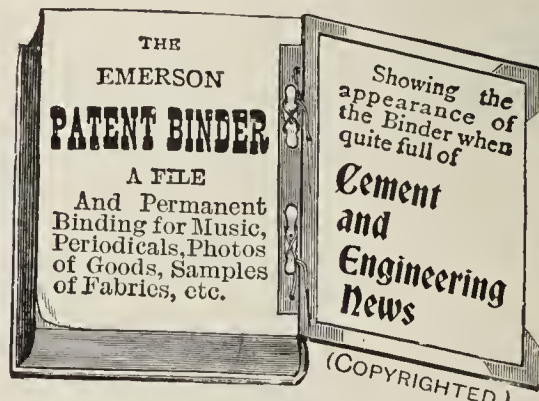
Industrial Commissioner, C. M. & St. P. Ry.

435 Old Colony Bldg., Chicago, Ill.

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FOR THE

CEMENT AND ENGINEERING NEWS



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PEACE RESTORED.

Peace is in sight! A declaration of peace means far more than a cessation of war. It means renewed business activity. It means a new awakening. An advancement all along the lines of business. You should be ready for the new era.

We have witnessed the supremacy of the American eagle in war and are again ready to have it perch in peace over a land of plenty. We are ready for the shriek of shells to give way to the hum of industry. We are ready for the smoke of battle to be supplanted by the smoke of manufacturing. We are ready for the army of soldiers to return to their benches, forges, desks and offices. The touch of war has embued the business world with a new activity, a new aim for success. In war it's the man who is in the front rank who gets the most honor. In peace it is the man who is in the front rank of business, ever striving to advance, who plants his flag upon the citadel of success.

The business of the country has been shattered by war. It will take the best of cement to mend the breaks. If you desire to make the very best brand of cement, you will need the very best machinery. We are manufacturers of the most approved Tube and Ball Mills, special grinding machinery and all classes of machines for manufacturing cement by the various processes. Our machines are "Built Right and Run Right." A postal and a minute will bring particulars.

THE AMERICAN CLAY-WORKING MACHINERY CO.,
BUCYRUS, O., U. S. A.

CUT THIS OUT AND FORWARD TO THE PUBLISHER.

Publisher of CEMENT AND ENGINEERING NEWS,
161 La Salle Street, Chicago.

Please send CEMENT AND ENGINEERING NEWS to my address for one year, for which I agree to pay TWO DOLLARS.

[GIVE STREET AND NUMBER.]

189

CEMENT

.....AND.....

ENGINEERING NEWS



TRACK ELEVATION SIXTEENTH AND CLARK STREETS, CHICAGO.

Brownell Improvement Company, Contractors, Chicago.

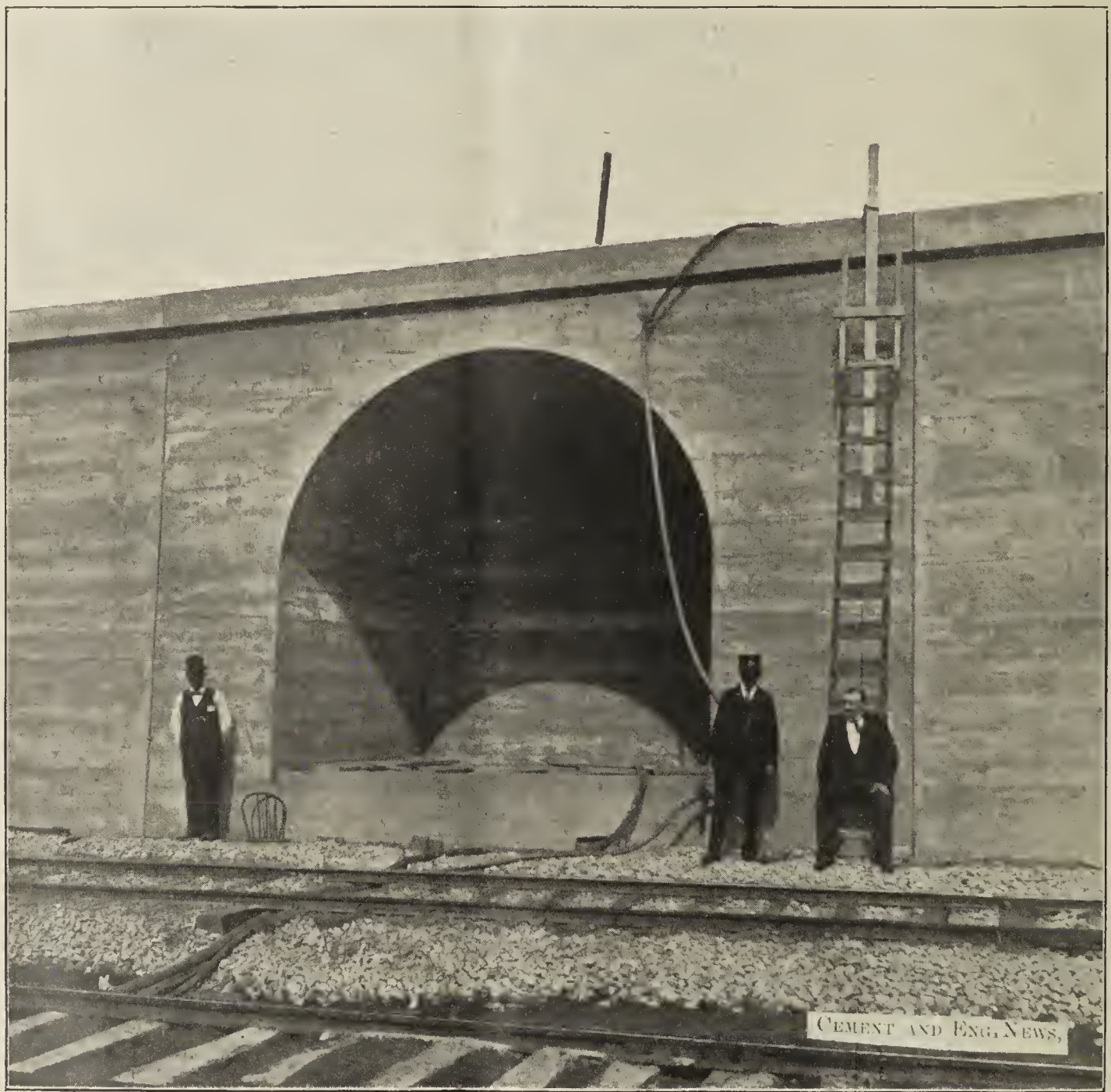
A section of the north concrete retaining wall looking west. Over 12,000 barrels of T. Millen & Co's Wayland (N. Y.) Portland cement consumed which was furnished by A. J. McBean & Co., Chicago.

CONCRETE CONSTRUCTION IN ELEVATING CHICAGO RAILROADS.

The city of Chicago, under numerous ordinances, is enforcing an extensive system of track elevation, covering 115 miles of main tracks, against all railways within the limits of the city, with the view of eliminating grade crossings. This work is well under way, and in several instances nearing completion. Twenty-three (23) different trunk lines centering at Chicago are affected by the various city ordinances whereby 271 grade crossings will be eliminated

exists the most complicated and intricate network of railway crossings to be found on the globe, as shown in Fig. 3. The Clark street highway crossing at this point has the reputation of being the most dangerous and fatal crossing in the city because of the heavy traffic passing over it daily. Statistics from the city track elevation department show 743 trains with 3,952 cars cross Clark street between 6 A. M. and 12 P. M. During these 18 hours 827 street cars with 16,540 passengers pass over the same point; during the same hours 2,232 wagons, trucks and other vehicles

is the extensive use of Portland cement concrete, of which we present several illustrations of the retaining walls. More than 25,000 cubic yards of this material will be consumed at the 16th street crossing. Fig. 4 shows the cross section of the vertical concrete retaining walls 21 ft. above the foundation, which rests on solid blue clay. The concrete mixing machinery is mounted on cars and operated by steam. The crushed stone and cement is handled in car lots and forms part of the train conveying the mixing machinery. The concrete is deposited rather wet and well



TRACK ELEVATION SIXTEENTH AND CLARK STREETS, CHICAGO.—Brownell Improvement Co., Contractors, Chicago.

Fig. 1.—Concrete arch recess in north retaining wall. Over 12,000 barrels of T. Millen & Co's Wayland (N. Y.) Portland cement consumed which was furnished by A. J. McBean & Co., Chicago.

when the entire work is completed, at an approximate estimated cost of \$17,400,000, of which more than \$6,000,000 has been expended to date and fully \$9,000,000 will have been expended in track elevation before the end of the present year.

The most difficult problem encountered in this system of track elevation is found in the vicinity of the 16th street crossing at Clark street, where

make this crossing. During the full 24 hours of a single day 5,500 cars make this crossing. The plan of track elevation centering at 16th street was worked out by James Dun, chief engineer of the Atchison, Topeka and Santa Fe Railway and involves separate grades for the different railways crossing at this point and for the Clark street electric line.

One of the interesting features of the present system of track elevation

tamped.

Fig. 2 shows an angle in wall forming the west boundary of Clark street, with a right angle coned due west.

Fig. 1 shows an arch in the north concrete masonry wall, with openings at the base connecting with sewers extending to the Chicago river. The tracks will be raised above the floors of this arch, permitting the rain to flow directly into the river. The Brownell Improvement Co. of

Chicago are the contractors for all the concrete masonry at this point. The work was commenced April 11, 1898 and will be finished October 1. The elevation and progress of the work has been unusually satisfactory. There has been less than \$25.00 worth of damages and no accident on the work. The heavy rail traffic has not been delayed to exceed 25 minutes during the entire progress of the work. Maj. G. H. Vaughan, C. E., of the engineering staff of the Santa Fe railway is the engineer in charge, John O'Neill is superintendent of track elevation for the city and T. P. McDonough is track elevation engineer. Large quantities of high grade Portland cements have been

The track elevation in the city of Chicago is of greater magnitude than has ever been attempted by any municipality on the globe and will be an object lesson to railway construction engineers all over the world.

Importations of cement at the port of New Orleans from January 1 to December 31, 1896, 300,068 bbls. 1897 271,795 bbls., 1898 to August 31, 155,083 bbls.

POSITION WANTED—By a cement chemist. Best references furnished; late with A No. 1 company. Address, "Chemist," care *Engineering News*, 161 La Salle street, Chicago, Ill.

CEMENT IN CANADA.

MONTREAL, Sept. 21, 98.

The arrivals of cement for the past week were only 324 bbls. English, as against 1,250 English and 7,922 Belgian and German for the previous week, making a total to date for the season of 155,653 Belgian and German, and 21,424 English. The situation of the market since our last report is unchanged. The undertone is firm and prices are fully maintained at the recent advance. The demand for carload lots continues good and there is an active enquiry for round lots for special delivery, but no actual transactions have taken place yet, owing to the fact that im-



TRACK ELEVATION SIXTEENTH AND CLARK STREETS, CHICAGO.—Brownell Improvement Co. Contractors, Chicago.

Fig. 2.—Concrete retaining walls, west line of Clark street, looking north on Clark street. Over 12,000 barrels of T. Millen & Co's Wayland (N. Y.) Portland cement consumed which was furnished by A. J. McBean & Co., Chicago.

consumed on this work, 3,000 bbls. of Atlas Portland cement, 5,000 of Star Bonneville Portland cement, several thousand bbls. of Iron clad Portland cement, T. Millen & Co.'s Wayland N. Y., Portland cement, over 12,000 barrels bbls., furnished by A. J. McBean & Co., 78 LaSalle street, Chicago.

Thos. Millen & Co., are to be congratulated on the excellent quality of cement furnished for this great work. They began the manufacture of Portland cement in the early seventies and have continued down to the present day.

E. H. Sargent & Co., 106 and 108 Wabash ave., Chicago, will equip the laboratory of the Coldwater Portland Cement Co. of Coldwater, Mich. This firm is prepared to furnish every requisite used in cement laboratories. This house is perfectly reliable and merits the confidence of patrons. Their card appears in our advertising columns.

A GOOD INVESTMENT.—Portland Cement Mill (new) and 15 acres of land for sale at Baltimore, Md. Price in the fee \$40,000. Address "Cement" P. O. Box 581, Baltimore, Md.

porters are holding off as they are experiencing some difficulty in placing orders with makers abroad, even at the advance noted two weeks ago. On the whole, however, a fairly active trade is doing. We quote English brands, \$2.25 to \$2.35; German, \$2.35 to \$2.50, and Belgian, \$1.85 to \$2.05 per bbl. ex-wharf.

The Empire Portland Cement Works, Warners, N. Y., is under the able management of Charles A. Lockard, with E. Bravender as superintendent. The output of this plant is 300 bbls. per day.

CEMENT AND ENGINEERING NEWS.

(PUBLISHED MONTHLY)

WILLIAM SEAFERT, Editor and Publisher.

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ADVERTISING RATES SENT ON APPLICATION.

"This world belongs to the energetic."

Chicago, September, 1898.

CORRESPONDENCE.

We solicit correspondence on all matters of general interest to the cement trade in all of its branches. Engineering notes, public improvements, and facts and opinions drawn from practical experience will be welcome.

PACIFIC COAST TRADE.

The use of Portland cement on the Pacific coast is greater per capita than in the region east of the Rocky mountains, almost the entire consumption being imported from Europe, with a small importation from the Green Island Portland cement mill, under English management at Green Island, off the coast of China, near Hong Kong. Pacific coast prices rule high, averaging over \$3.50 per bbl. for the imported article, and over \$3.00 per bbl. for American brands.

There are now two small Portland cement plants operated in Southern California. These works lack Eastern enterprise as well as capital and are not cultivating the fair field of enterprise, which the demand for Portland cement affords, more than one million bbls. of European Portland cement being imported annually.

During the present season there has been a veritable cement famine in Southern California. The largest and most important works have been detained for months, owing to the non-arrival of several large cargoes of cement in transit from abroad.

There is an abundance of high grade cement material at various points along the railway traversing the state of California. This is particularly true of the Atchison, To-

peka and Santa Fe Railway system, which presents unusual opportunities for locating Portland cement mills. The California trunk lines are liberal consumers of Portland cement, using hundreds of thousands of barrels annually and are willing to patronize industries on their own lines. We reiterate that the Pacific Coast is, considering the high prices ruling there, a most inviting field for the establishment of Portland cement plants, which, if carefully and systematically operated, will yield large returns on the capital invested.

A NEW CEMENT PLANT.

The Marquette Cement company, an Illinois corporation, has been organized with a capital of \$250,000, for the purpose of manufacturing exclusively high grade Portland cement. Their deposits are located on the Chicago, Burlington & Quincy and Illinois Central railroads, about one hundred miles southwest of Chicago, near Deer Park Ill. The capital of the Company is controlled by Pennsylvania, Cleveland and Chicago interests.

It is denied that extensive operations are contemplated, the scope and effort apparently being toward a limited product in quantity but of a grade and quality superior to anything that has yet been placed on this market. The Dickinson company of Chicago appear to be the active spirits in the undertaking, which would seem to be sufficient to guarantee the successful introduction of the Marquette company's product.

An advertisement in CEMENT AND ENGINEERING NEWS brings reward.

HIGH PRAISE FOR THE "CONSTITUTION OF HYDRAULIC CEMENT,"
BY S. B. & W. B. NEWBERRY.

"No piece of work on the chemistry of cement comparable with this by Messrs. Newberry has appeared within the last ten years, and we congratulate the authors on the sound method, well-directed industry and clear reasoning which are its characteristics."—*The Engineer*, London, Dec. 24, '97.

Copies of this work will be sent to any address on receipt of 25 cents by the CEMENT AND ENGINEERING NEWS.

Owing to the shortage of Portland cement and the low prices for natural the numerous cement mills in Clark county, Indiana, are now running full time. It is impossible to secure cars enough to ship the cement.

The Blue Rock Cement Co., New Albany, Ind., was incorporated. The incorporators are A. Heimberger, Joe Keebner of that city, and Frank Klausing of Jeffersonville. Capital stock \$75,000. The mill will be ready by January 1.

CEMENT CHEMIST WANTED—A thoroughly competent cement chemist wanted for Portland cement mill now being erected near Chicago. Moderate salary on starting, with provisions for increase with enlargement of plant. Address "Chicago Mill," care CEMENT AND ENGINEERING NEWS, Chicago.

A certificate of the consolidation of the Helderberg Cement company and the Howe's Cave Lime and Cement company was filed at Albany, N. Y. These companies form the Helderberg Cement Company. The capital is \$300,000, divided into 3,000 shares of common stock of the par value of \$103 each. The company will operate at Howe's Cave, Schoharie county, N. Y. The holders of stock in the old company are to receive stock in the new company share for share.

IMPORTS OF CEMENT INTO THE UNITED STATES.

WHERE FROM.	JULY.				SEVEN MONTHS ENDING JULY.			
	1897.		1898.		1897.		1898.	
	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.
United Kingdom....	16,492,131	54,825	12,054,128	41,166	65,550,660	211,314	37,098,513	126,158
Belgium.....	20,321,290	64,411	24,996,080	82,017	115,650,757	335,111	141,391,289	419,482
France.....	1,186,872	3,454			5,309,073	16,749	2,094,000	7,793
Germany.....	50,988,075	164,937	47,172,078	157,990	259,292,025	837,185	219,191,706	728,602
All Other Europe...	1,014,314	3,164	1,926,432	5,285	10,286,568	38,670	13,525,516	41,736
British North Am....	177,500	800	220,000	1,136	836,225	3,904	1,086,550	5,259
Other Countries.....					411	1	5,200	67
TOTAL.....	90,180,182	291,591	86,368,718	287,594	456,925,719	1,442,934	414,392,776	1,329,097
Domestic Exports of Cements, bbls.	9,581	16,608	2,161	4,951	33,504	60,749	21,454	41,61

There were 3,449,317 lbs. of imported Roman and Portland cements, etc., in the United States bonded warehouses on July 31, 1898, valued at \$9,951 against 5,007,363 lbs., valued at \$11,441, in July, 1897.

Imports of asphaltum or bitumen for July, 1897, were 15,435 tons valued at \$48,607; July, 1898—3,815 tons valued at \$15,484. For seven months ending July, 1898, 36,944 tons valued at \$113,628; for seven months ending July, 1897—84,389 tons valued at \$279,219.

ALLOWABLE MAGNESIA IN PORTLAND CEMENT.

By IRVING A. BACHMAN, Ph. D., D. Sc.

From *Municipal Engineering*.

(Continued from page 38.)

TENSILE STRENGTH, 1 PART CEMENT 3 SAND.
IN KILOGRAMS FOR 1 Q.

No.	1 Wk	4 Wks	13 Wks	25 Wks	50 Wks	90 Wks	P C MgO
1	18.0	22.5	..	26.3	34.1	37.8	4.8
2	15.5	23.4	..	28.0	33.0	36.1	3.8
3	14.8	20.0	28.3	29.7	30.5	33.1	4.1
4	14.3	20.1	22.8	25.8	28.3	32.4	4.6
5	13.5	19.4	..	27.3	29.6	31.0	5.0
6	13.6	16.9	21.5	25.8	32.0	31.3	5.7
7	11.0	18.5	22.0	27.0	32.7	30.4	6.4
8	17.6	20.8	30.0	30.5	29.8	26.0	7.6
9	11.0	16.5	..	20.8	22.5	20.0	9.1
10	11.2	15.5	14.5	18.0	22.3	18.3	11.5
11	14.0	17.5	21.3	22.5	19.4	16.8	13.2
12	12.1	14.8	18.8	16.6	15.0	13.8	15.4
13	9.0	12.4	13.2	16.1	13.0	11.4	19.2
14	6.0	10.0	13.0	14.1	11.0	8.4	23.3

In the high pressure boiling test the behavior was as follows: This test as carried out by the author is very severe and many so-called normal cements behave precisely as those with a magnesia content of over ten per cent.

Magnesia content.	At 3 atmos- pheres.	6 atmos- pheres.	10 atmos- pheres.	20 atmos- pheres.
0.8 p. c.	12.0 k.	20.0 k.	27.7 k.	32.3 k.
3.8 "	10.0	18.0	33.0	23.5
4.6 "	9.0	17.0	28.0	23.0
5.7 "	9.0	14.0	18.5	Swelling.
6.4 "	6.0	11.5	(Showing swelling.)	do.
9.1 "	Considerable expansion and swelling (soft).			Soft and swollen.
11.5 "	do.			
13.2 "	Swelled rapidly, boiled to pieces.	Disintegrat- ed after rap- id swelling.	Disintegrat- ed after rap- id swelling.	do.
15.4 "				

The wires show that CaO as well as MgO swells and softens.

The author closes his paper with the statement that the behavior of cement is not dependent upon its magnesia content, but upon its chemical combination.

F. Kalalewski's* researches cover more years than those of any other investigator, and the results are tabulated as follows.

*Die Versammlung nimmt davon-kennnt das die M. Commission ermittelt, dass am Gehalt von 5 Pro C. Magnesia in gebräuntem Cement nach zwei-jähriger Untersuchungsdauer zu keinerlei Bedenken Anlass gibt, und achleisst sich dieser Ansicht an.

† Bericht über Untersuchungen betr. Wirkung der Magnesia in Portland Cement. (Hanover, 1893.)

* Ueber das Verhalten der Magnesia-cemente in der Praxis.

† Dingler, 291.

† Topfer Zeit., 1893.

* Thonind. Zeit., 1893.

† Jahr Ber Po., 1893.

§ Annales de l'Asso. des Ingenieurs sortis Ecoles spéciales de Gand.

No.	CaO	MgO	SiO ₂	Al ₂ O ₃	Expanded very little—After 4 yrs. expanded.	Swelled rapidly—After 90 days fell to pieces in drying—After 1 year rapid swelling.	No swelling—After 10 yrs. hard and intact.	Swelled a trifle—Some expansion up to 8 yrs. —after 10 yrs. no expansion.	Swelled rapidly—After 8 yrs. only the larger pieces held together.	Volume constant—After 10 yrs. still good.
1	23.6	20.0	1.86	1.18						
2	20.0	18.0	1.40	1.49						
3	17.0	17.3	1.63	3.99						
4	18.5	1.92								
5										
6										
7										

We note that where the basic coefficient is maintained to what we believe to be the best composition the samples show very little expansion and after ten years remain hard and intact, regardless of the high percentage of magnesia.

Grauert† cites the personal knowledge of cement used in 1865 and 1867 containing 4.57 and 5.07 per cent. magnesia used in a very damp garden wall that has held unusually well and shows no sign whatever of disintegration.

Schott‡ experimented with cements containing 3.5 to 8.0 per cent. magnesia, using Bauschinger's expansion apparatus; he found that up to 6 per cent. of magnesia the tensile strength remained the same.

Cements containing 7 to 8 per cent. of magnesia gave a slightly greater expansion than those magnesia free, only in neat tests. The same cements with three parts sand gave no greater expansion than normal cements.

Meyer's* research was made on the basis that magnesia replaces lime; his tests seemed to show that the decline in the tensile strength of cements high in magnesia did not appear for a long time in cements tested neat. His cement containing 6 per cent. magnesia remained normal in every particular.

Schiffner† found no unusual behavior in cements containing magnesia over that of normal cements. Cements with 6.97 per cent. magnesia tested neat showed an expansion of 0.08 millim.; from 11 to 14 months no expansion whatever. Cements with three parts sand showed only 0.045 millim in four months, and from 4 to 13 months no further expansion.

1894.

Proceedings Association of German Cement Makers, February 23, 24, 1894.

|| This commission ruled that after a three years' investigation the tests show no injurious effect from a magnesia content of 5 per cent. in burnt cement.

§ The commission, including Camerman, Casse, DeSchuyler, DeSibille and Pineur, appointed by the Brussels section of engineers to determine rules for classification and tests of hydraulic cement laid down no rules in reference to magnesia content.

*A technical review of cement by Dr. Dybinsky covering the subject from 1891 to 1894 has the following to say about magnesia in cement:

As in previous years we have a vigorous prosecution of the investigation of this subject; a number of new authors have taken up the subject in great detail.

Summing up the matter he says all investigators agree that 5 per cent. of magnesia in burnt cement is harmless. No maximum limits of safety have been defined.

The laborious and painstaking researches of Erdmenger show that magnesia, per se, is harmless, acting indifferently like so much sand. The trouble, he states, is overcome if the equivalent of magnesia is added as lime; then the supposed injurious effects of magnesia disappear.

1895.

Proceedings Association of German Cement Makers, 1895.

Schott, Meyer and Arendt report that the investigation covering five years failed to show an injurious effect of magnesia in Portland cement.

The presence of magnesia up to 10 per cent. causes no harmful expansion or cracking of the cement even after several years. Dyckerhoff reported no change in cement with a magnesia content of 3 per cent. Above 4 per cent., if sintered, whether added or substituted for a part of the lime, it has an injurious effect after long periods. If not sintered, however, as much as 18 per cent. may be present without exhibiting any bad effects.

He recommended the continuance of the allowable limit as for the previous year, namely 5 per cent.

The commission ruled that 5 per cent. be continued, but that the matter be held under advisement and that further research on the subject may change the former ruling and name a higher percentage of magnesia as a harmless content.

Briefly reviewing the situation, we have the views of LeChatelier, who regards magnesia as functioning sim-

|| "Die bez commission hat beschlossen" "Die commission halt nach ihren Versuchen, welche sich nur zum geringen Theil bis auf 3 Jahre erstrecken, eine schädliche Wirkung der Magnesia bis zu 5 proc. imgebräuntem Cement auch bis jetzt nicht erweisen."

* Dingler's, 294-89.

ilarly to lime and that of Erdmenger who considers it inert, acting indifferently like so much sand; the latter views are supported by very voluminous tables, being the result of very laborious and painstaking experiments covering many years.

Before the subject was critically investigated it was customary to charge all failures of cement to magnesia content, whether such failures were caused by its chemical composition *per se*, or by the final manipulation of the product by the consumer. So firmly had this become fixed into the minds of engineers and consumers in general that Russia, in giving out its official specifications for cements rejected everything over 2.5 per cent. magnesia. This ruling was followed by the other countries, which then led to a rigorous investigation of the subject. We find that in 1891 the maximum permissible was named at 2.5 per cent. In 1893 the ruling of the Association of German Cement Makers was that five per cent. was harmless. In 1894 we find the limits of maximum magnesia disappearing from most of the official specifications abroad. In 1895 the commission of the Association of German Cement Makers hold the matter under advisement, feeling that further research will place the limit of safety much higher.

Dyckerhoff, who has wielded the battle-ax against magnesia in cement more vigorously and persistently than any other investigator, has from year to year raised his limit of safety, and in his last report before the association states that as high as eighteen per cent. may be present if the product is not sintered; that is, if there are no incrustations or locking up of improperly burned material.

Summing up the situation we find that cement of the average composition and burning exhibits a tendency to blow when the percentage of magnesia reaches 11.5 per cent., but in mixtures of cement and neutral material as in actual use no such blowing is observed under 15.4 per cent.

The naming of 2.5 per cent. magnesia as a maximum by some engineers in recent specifications in this country is purely arbitrary, based on no facts and supported by no proof that magnesia present to the extent 2.5 or even five per cent. has or ever will create mischief.

From investigations on this subject carried on for a number of years I am satisfied that the percentage of magnesia within six per cent. has very little to do with the behavior of cement. There are other and more important conditions that change its character and particularly that of constancy of volume.

CONCRETE SIDEWALK CONSTRUCTION.

[Copyright by the Garden City Sand Co., Chicago.]

This work is divided into two classes, one for business streets, where strong walks are needed, which are subjected to great wear, which are built six inches in total thickness and have a plaster top one inch in thickness. This top varies in different specifications between three-quarters of an inch and two inches. The best and most economical results are obtained with the one-inch top. The other class, for residence streets, is built of a total thickness of four inches and the top is made one-half inch in thickness. The same want of uniformity with regard to top thickness is observable here as in the heavy traffic walks, the variation being between one-fourth and three-fourths of an inch. With this explanation I will give specifications for the lighter walk only and the changes required for the heavier class of work will readily appear.

General specifications for concrete sidewalks as they are successfully built in the smaller cities.

FOUNDATION.

The site of the proposed walk will be carefully graded to a grade ten (10) inches below the top of the finished walk. If filling is required it must be placed in layers not exceeding three inches in thickness and be uniformly tamped or rolled to bring the site up to the proper height in a solid and substantial condition. Where possible, the top of the embankments should extend at least one foot beyond the proposed walk in every direction. Slope of embankment should be generally two feet out for each foot in height and should never be less than one and one-half feet out for each foot of height. Where excavations are made they should be made wide enough to allow ample room for stringers and slopes. In such case a walk should be built partly in excavation and partly in embankment. In case part of the site is above and part below the proposed level the whole surface should be spaded to a depth of at least four inches below the ground grade, then leveled off and tamped or rolled as provided above.

CINDER BEDS.

After the ground has been properly graded a uniform layer of cinders or clean gravel shall be spread over the entire surface, to be covered by the walk and extending at least six inches beyond it all around; these cinders shall be thoroughly wet and rammed and their top shall be brought to a uniform surface four inches below the top of the finished walk.

STRINGERS.

Stringers of two by four scantling shall then be placed along the edges of the walk. These stringers shall be carefully set to grade and line and be thoroughly staked to place. Cross partitions of two by four material shall then be set not exceeding four feet six inches apart. All material used for stringers shall be straight and true.

PLACING CEMENT.

Each alternate stone shall then be made, after first wetting the cinders thoroughly and evenly with a sprinkling can or hose. The concrete for the body of the stone will be shoveled into place and leveled off about even with the tops of the stringers and thoroughly rammed with rammers not over six inches square, weighing not less than twenty pounds, the ramming to continue until it brings a film of water to the surface. This ramming should bring the surface of the concrete uniformly one-half inch below a straight edge, resting on the tops of the stringers and if not it is to be trimmed to this height and the top coating immediately put on.

PLACING TOP COATING PLASTER.

As soon as the concrete has been properly tamped and trimmed the top coating shall be spread with a straight edge and as soon as it is in the proper condition shall be floated to a true and smooth surface and finished with a trowel or brush, care being taken not to trowel too much and exhaust the surface. As soon as the alternate stones first put in are set sufficiently to permit the removal of the cross partitions without damage to the existing work these partitions may be removed and the walk completed in the manner described above. As soon as any part of the walk has set and within twelve hours after the top has been put on it shall be covered with moist sand, this sand to be kept wet until the whole walk is completed and turned over to the traffic. No walk is to be turned over to the traffic until the last stone is at least forty-eight hours old.

PORTLAND CEMENT.

Portland cement used on this work is to be first-class American or German Portland cement and must be delivered at least ten days before required for use in the work, so that tests can be made. As soon as the cement is delivered the engineer shall be notified in writing and tests will be immediately made. The use of cement will not be permitted until it has been tested.

QUALITY TESTS.

The cement used on this work shall be such as will satisfactorily pass the following test requirements: Ce-

ment briquettes shall have a tensile strength after setting twenty-four hours in moist air of at least one hundred and fifty pounds per square inch. After twenty-four hours in air and six days in water the tensile strength shall be at least 450 lbs. per sq. in. Pats shall be made on glass and under the following conditions shall show no blowing, swelling or cracking at edges: Placed in damp air seven days, until set in air, and six days in water at ordinary temperature, until set in air, then for six days in vapor of boiling water.

FINENESS.

At least ninety per cent by weight shall pass through a standard No. 100 sieve, 10,000 holes per square inch.

COLOR.

The cement used to be such as to give the surface a white or light grey color which shall be uniform throughout. Any block showing blotches or shades different from other blocks or which are broken or marred will be condemned and must be taken out and replaced by the contractor.

CRUSHED STONE AND GRAVEL.

The crushed stone used on this work shall be the product of a crusher working on clean stone. All stone larger than one and one half inches in any dimension shall be screened out, but all of the product finer than the above shall be used. If gravel shall be used it shall be washed gravel and shall include all sizes from coarse torpedo sand to stone whose greatest dimension is one and one-half inches. All stone and gravel to be clean when used.

CONCRETE.

All concrete used on this work shall be composed of one part of Portland cement of the quality specified herein, three parts of washed sand and five parts of crushed stone or washed gravel, all proportions to be accurately measured. The sand and cement in the proportions above specified shall be thoroughly mixed together dry in the manner specified for cement plaster. The measured quantity of crushed stone or gravel shall be spread on the mixing platform. The sand and cement mixtures shall then be shoveled on top of the stone or gravel and the whole mass mixed by turning with shovels at least three times. It shall then be wet in such quantities as can be immediately placed in the work and thoroughly rammed; ramming and mixing to be to the satisfaction of the engineer.

PLASTER.

Plaster to be composed of one part by measure of Portland cement of the quality specified herein and one

and one-half parts, by measure, of washed torpedo sand or crushed granite of a quantity approved by the engineer, the measurements of the proportional parts used to be made in measuring boxes and to be exact. The sand and cement to be mixed dry by turning with shovels or hoes and then the mixture to be cast through a screen before wetting. Water in a proper quantity shall be added and thoroughly mixed with the sand and cement, in such quantities only as are needed for immediate use.

REMARKS.

To sum up the above and bring out the essential points a little more strongly I will say in closing that a uniform foundation, good and uniform methods, thorough mixing, good proportions and good materials are the essential features of good walks.

The methods and mixtures described in the above can be departed from and good results obtained. Departure from them requires judgment and practical knowledge of the materials and requirements. Following them will give good results and requires only painstaking care.

NOTE—The writer of this article, L. B. Merriam, C. E., maintains an office at DeKalb, Ill., and does consulting work for waterworks, sewers and pavements and makes a specialty of cement works of all classes.

ANNUAL MEETING OF THE AMERICAN SECTION OF THE INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS.

The first annual meeting of the above named association was held at the Engineers' Club, 1122 Girard street, Philadelphia, August 27, 1898.

The afternoon session was called to order at 3.30 P. M. Prof. Mansfield Merriman presided, with Richard L. Humphrey as secretary. After the reading of the minutes of June 16th, 1898, the by-laws which had been proposed by the executive committee were taken up and considered section by section. After several minor changes they were adopted as printed.

The appointment of American representatives on the international committee which will consider the problems submitted at the last convention at Stockholm, was next considered. The members making suggestions as to the proper American representatives.

Dr. R. G. G. Moldenke thought the subject of cast iron should be considered by international committees and was requested by the chair to present this question in the form of a resolution, for consideration at the evening session. Prof. W. K. Hatt inquired into the status of impact tests in Europe.

Mr. Henning stated that in Europe it was considered equal to any. Nothing has been accomplished with the test in this country; the test itself being in a very crude state. Mr. William R. Webster thought Mr. Henning's remarks were entirely too broad and sweeping. He personally had inspected many tons of steel rails by means of the drop test with excellent results.

Prof. Edgar Marburg inquired whether the impact test of the Bethlehem Iron Company was used for scientific purposes. Mr. M. White stated that the Bethlehem Iron Company had two impact machines, one, the regular type in which the "drop" runs in guides, and another gotten up especially to test Russian armor plate. It is a question of the fatigue of metal and not of breakage; a question of what material will last the longest and give the best service.

It is a question of ductility or of elastic limit. The Bethlehem Iron Company has made lots of tests but are more at sea than ever concerning the value of drop tests. The chair thought the reason the drop test had not succeeded was due to lack of information as to the methods for making the test. Mr. Kreuzpointner thought the impact or drop test, while it might be considered very crude, gave very valuable results. If an axle, for example, fails to stand this test the results show it does not stand in actual service.

The drop test for railroad materials, or any material that has to stand unusual strains, is of very great value. While the present test may be crude we are not prepared to condemn it as it is a very reliable test as a whole. Mr. Henning moved that a committee of three be appointed to report to the American section on the present state of the knowledge of impact tests.

The meeting then took a recess. During the intermission the members dined at the Hotel Lafayette. The evening session was called to order at 8.30 P. M.

Dr. Moldenke presented the following resolution: Resolved that the council of the International Association be requested to appoint a committee to investigate methods of testing cast iron. This resolution was carried unanimously.

Mr. William R. Webster, in the unavoidable absence of Dr. Dudley, opened the discussion of the subject, "The Relation of the International Association to Producers and Consumers," and was followed by Mr. White, Dr. Moldenke, Messrs. Wille, Kreuzpointner, Lesley, Whitney and Henning.

Mr. Henning opened the discussion of the subject, "In What Manner will the Adoption of Standard

Specifications Improve Industrial Methods and Processes." Messrs. Krenzpointner, Lesley, Humphrey, Davies and Professors Hatt and Marburg participated in the discussion which followed. Considerable discussion of a miscellaneous character brought the first annual meeting to a close.

Among those present were: Bethlehem Iron Co., represented by M. M. White of Bethlehem, Penna.; Gus C. Henning, New York, representing American Society of Mechanical Engineers; Richard L. Humphrey, in charge Testing Laboratory City Hall, Philadelphia; Prof. W. K. Hatt, Purdue University, Ill.; Paul Kreuzpointner, Testing Department Pennsylvania Railroad, Altoona, Pa.; Dr. R. G. G. Moldenke, Pittsburg, representing Technischer Verein, Pittsburg; Prof. Mansfield Merriman, Lehigh University, So. Bethlehem, Penna.; F. A. Riehle, Riehle Bros. Testing Machine Co., Philadelphia; Louis R. Shellenberger, Philadelphia; Mr. Mueser, representing Technischer Verein, New York; William R. Webster, Philadelphia; H. V. Will, Engineer of Tests, Baldwin Locomotive Works, Philadelphia; Prof. Edgar Marburg, University of Pennsylvania, Philadelphia; Robert W. Lesley, Philadelphia; Chas. T. Davies, Asst. Chemist, Philadelphia and Reading R. R., Reading, Pa.; Joseph W. Brainwell, Supt. Riehle Bros. Testing Machine Co.

LIST OF PROBLEMS TO BE CONSIDERED BY THE INTERNATIONAL COMMITTEES.

Problem 1. "Taking as basis the existing conditions of inspection to establish uniform International rules for setting and inspection of all kinds of iron and steel." William R. Webster. One member still to be appointed.

Problem 2. "Determinations of methods of test of the homogeneity of iron and steel with the object of eventually employing these methods for inspection." Booth, Garrett & Blair, Gus C. Henning, Prof. Thomas Gray, Paul Kreuzpointner, A. A. Stevenson, William R. Webster.

Problem. "Preparation of uniform methods of tests of paints as protection against corrosion of railroad structures." Henry B. Seaman, J. A. L. Waddell. Two members still to be appointed.

Problem 3. "Unification of methods of test of tile pipe." One to be appointed.

Problem. Supplemental to the solution of the question of standard consistency of standard mortars. "Determination of conditions which will produce approximately similar density of tension and compression of briquettes." Richard L. Humphrey.

Problem 4. "Investigation of the behavior of low steel under abnormally low temperatures." Prof. George W. Bissell.

Problem 5. "Methods of testing welds and weldability." One to be appointed.

Problem 7. "Collection of masses of material for the preparation of standard piece tests, with special reference to axles, tires, springs (car), cast and wrought iron pipes, as well as the separate parts of structures." One member to be appointed.

Problem 10. "Investigations of the most practicable methods of polishing and etching for microscopic study of wrought iron." Albert Sauveur.

Problem 11. "Study of the relation of chemical composition to weathering qualities of building stones. Study of the effect of the gases of combustion, especially sulphurous acid." One member to be appointed.

ally sulphurous acid." One member to be appointed.

Problem 12. "Study of the relation of the chemical composition to the qualities of roofing slates." Prof. Mansfield Merriman.

Problem 14. "Determination of rapid methods for determining conditions of constancy of volume of hydraulic bond materials." Richard L. Humphrey, William W. Maclay.

Problem 15. "In what manner can hydraulic bond materials be tested for tensile strength in the shortest period of time." Dr. Charles J. McKenna, William W. Maclay.

Problem 16. "Testing and evaluating the resolutions of the conferences relating to the determination of adhesion of hydraulic bond materials." Booth, Garrett & Blair and one member to be appointed.

Problem 17. "Examination of propositions for the uniform determination of the value of puzzolanas as mortars." Two members to be appointed.

Problem 18. "Investigations of causes of the abnormal behavior of cements as to time of setting." Two members to be appointed.

Problem 19. "Investigation of the effect of fecal matter on the strength of hydraulic bond materials." Two members to be appointed.

Problem 22. "How can the inspection of lumber assure protection against the growth of fungi (merulius lacrymans)." Prof. John B. Johnson.

Problem 23. "Determinations of fundamental methods for testing lubricants (oils)." One member to be appointed.

American committee to report to the American Section "On the present state of knowledge of impact tests." Prof. W. K. Hatt, Prof. Edward Marburg, James E. Howard.

TULLOCH & CO.'S MONTHLY MARKET REPORT.

LONDON, August, 1898.

The cement trade throughout Great Britain, Germany and Belgium, continues in a record state of activity. The combined demand for home consumption and export largely exceeds current production, and in many districts building work is not only retarded but at a standstill, through inability on the part of contractors to obtain adequate supplies of cement. A further advance in selling values for both home delivery and export has been established, and many who have special orders to fulfill for prompt delivery are willing to pay a heavy premium to obtain the cement.

Whilst export inquiries continue active, both in England and on the continent, the high prices now asked by all the leading works tend to hold off foreign buyers. The main cause for present activity and advancing prices is to be found in the unprecedented demand for domestic requirements in Great Britain and on the continent. At no time within record have, concurrently, such large government and public works been undertaken in Great Britain and Germany, necessitating the employment of such large quantities of cement. Cheap money has also promoted a large amount of private building. As a result of careful inquiries we have made amongst the English and continental mills, we are of opinion that enough orders are on the market to employ makers maximum production for the next five or six months. Already, in several cases,

works have been approached with regard to contracts for 1899, and offers have actually been made representing an advance on current rates.

In the English trade the mills on the Thames and Medway continue quite unable to cope with demand and large quantities of continental cements are being imported into Great Britain at high prices. Notwithstanding this invasion of foreign cements the English makers find no sign of diminishing demand, and for home trade are obtaining prices varying from 7 to 8 shillings per ton more than the rates current at the commencement of the year.

Owing, in fact, to the good prices being paid for the home trade many of the works are not at present laying themselves out for expert trade and this may partly explain the falling off in exports for the first seven months of the present year. Statistics are as follows:

Total Exports of English Cements.

January to July, 1896....	212,377 tons
" " " 1897....	234,651 "
" " " 1898....	202,343 "

For export we quote first-class brands 6 shillings 8 pence to 7 shillings 3 pence per bbl., according to delivery f.o.b. Thames.

In Germany export prices have advanced to the equivalent of 9 pence to 1 shilling per bbl., and at present there seems no check in demand. A large amount of orders are held over on account of inability on the part of purchasers to secure delivery.

The following statistics of total exports from Germany over the first six months recording:

January to June 1895....	182,629 tons.
" " " 1896....	206,794 "
" " " 1897....	227,595 "
" " " 1898....	241,226 "

Demand from most foreign markets has shown an increase, but as regards the United States total exports January to June for the present year amount to 99,116 tons as compared with 102,796 tons for same period in 1897. This slight falling off is no doubt due to the recent war.

We estimate that the maximum total production of the German mills for this year will reach from 17,000,000 to 18,000,000 barrels, and if, as general estimates show, the home and export trade combined will require 19,000,000 to 20,000,000 barrels during this year, it is evident that there will be a shortage and every incentive on the part of the mills to maintain, if not advance, their prices. Unless the mills have an opportunity during next winter of accumulating stock, a repetition of the present shortage is not improbable during 1899.

In Belgium demand continues active. The works producing high

grade artificial cement have sold all their production. Nominal selling values to-day is 6 shillings 3 pence to 6 shillings 4½ f.o.b. Antwerp. A very large quantity of artificial cement will be required for local use in Belgium during the next few months and whilst, no doubt, every effort will be made to increase the production, it is evident the works will not have a very large quantity available for export.

Best quality natural cements are in good demand and prices are well maintained. Low grade qualities are easily obtainable, but even these are being held for an advance. Our current quotations are as follows:

Natural Cements.

Best quality....	4s. 9d.	to 5s.	per bbl.
Second "....	4s. 7½d.	to 4s. 9d.	" "
Third "....	4s.	to 4s. 3d.	" "

F.o.b. Antwerp.

In conclusion, the general tendency in foreign markets has been to use up existing stock before paying the advance prices now asked by the makers. Thus, at the present time foreign markets, with the exception of Japan, the Straits, and one or two other minor Eastern markets are overstocked.

It should not be overlooked that, the last three months exports of cement to the United States (which continues a large consuming market for German cements) has been small, but with the conclusion of hostilities an immediate resumption of demand will probably lead to further drain on the German and Belgian works.

CEMENT ROOFING TILE.

Cement roofing tiles, the manufacture of which has been introduced about two years ago in the United States, is of long existence in Europe. In Bavaria, Switzerland, and other countries where the climatic changes are sudden and of destructive nature, and where no roofing material has withstood the ravages of elements any considerable length of time, cement tiles have been found efficient in every respect. For more than 25 years cement tiles have been in use and to-day, with the great improvement in shape, style, color, etc., they have superseded mostly every other kind of roof covering and especially where architects and builders aim to have the best article and to conform to architectural designs of the structure. In fact, since the use of cement for building purposes has been so well understood, all the prejudices which at first appeared against the use of cement roofing tile has entirely disappeared in European countries and all that remains to a general adoption in place of slate or burnt tiles, is that the manufacturers

use a good cement in proper proportion—one to three—and select one or more desirable shapes, principally with head and side locks. One of the best shapes which has been adopted by many manufacturers in nearly all parts of Europe is shown by a cut given in these columns.

The method of making cement tiles is very simple and also inexpensive. No expensive machinery, no firing kilns or expert superintendents are needed. All it requires above everything else is a thorough mixture of good cement and sand, a careful workman who knows how to pound concrete into proper shape and to give it a smooth finish, all of which can be acquired in a day or two by almost any workman of ordinary skill and intelligence. To be more



FRONT VIEW.



REVERSE VIEW.

explicit it may be stated that the so-called machines consist of a table about four feet square on which an iron frame is fastened. In this frame an iron plate is laid upon which the damp concrete—cement and sand—is thrown. The workman pounds this with irons into a shape as shown on face of tile, after which dry cement color is sifted on the surface and rubbed off with a smoothing iron. The iron plate, above spoken of, is lifted out of table frame by means of a foot lever and the tile thus made placed on a rack to dry. Another iron plate is put into table frame and the workman continues the process of making tiles as herewith briefly described. A man can make about 150 tiles a day. It takes from 12 to 24 hours in ordinary temperature for the tiles to dry sufficiently to permit taking off the iron plates, when they are piled up in convenient places to harden. It is essential to give them lots of water regularly for several days to insure a more perfect silification.

There are other trivial matters connected with the manufacture, but we deem it hardly necessary at this time to enter minutely into every detail. To make hips, ridges, finials

ornaments, etc. is similar. Those interested in cement work of this kind can receive full information by applying to the Petrolic Tile Co., Ltd., 705 Cass Ave., Detroit, Mich., which firm is offering cement roofing tile machinery for sale.

It will not be amiss to add that the United States is far below European countries in the manufacture of artificial stoneware, be it roofing or flooring tiles, building stones, ornaments, etc. Time has proven that cement materials, if properly constructed, are as enduring as most of the real stones, aside from the fact that the prices are far lower, and especially where ornamental designs are desired. In Russia, Germany, Austria, Sweden, France, England, etc., the use of cement for buildings is greatly encour-

aged by engineers as well as cement manufacturers and our suggestion to the cement producers in the United States to give the question of making roofing tiles careful consideration should not go unheeded. The Dykerhoffs have erected residences, bridges, structures of all kinds of cement to demonstrate the utility and durability of their products, and one might say that the success of their cement is mainly due to the efforts in this direction. Our cement manufacturers would do well to follow this example and if so the prejudice against our home product may be diminished, if not wiped out, a much larger quantity consumed and possibly prices advanced by a larger demand and consumption.

The Southern Kansas Cement Co. will erect a stucco mill at Burns, Kas. The town has donated a site. A bed of Ayatite seven miles from the town will be used for raw material.

A Portland cement maker of 30 years experience requires a position as manager of works. Best of references given. Address "Portland" care CEMENT AND ENGINEERING NEWS.

BIRMINGHAM'S BUILDING CURIOSITY.

The interest of the general public in matters of engineering difficulty is not usually marked, but we give from the *Birmingham Post* (Eng.) a sketch that will help to make clear the nature of an undertaking at present in its early stages in Carr's lane which may arise considerable interest.

This novelty has been described as "suspending a building," but the term is hardly correct, and disappointment has been expressed by those who have visited the spot under the impression that they would find a building hanging in the air, "suspended" by goodness knows what! The drawing mentioned will assist in making clear our description. The problem was to deal with a valuable site, with an equally valuable front-

nel 25 feet, which leaves only nineteen feet, resting upon a solid foundation. This cantilever supports 270 tons of the building, and as the front or overhanging part is so much longer than the other a gigantic weight in the form of a concrete block some 16 ft. by 15 ft. and weighing 160 tons, is suspended from the short end of the cantilever by steel rods 22 ft. long. The cantilever B supports the greatest load, 375 tons, and overhangs 21 ft. C. supports 360 tons and overhangs 14 ft., the overhang gradually diminishing to 4 ft. at F.

The drawing will convey an idea of the entire arrangement and the substantial nature of the building to be erected, although it is not entirely accurate with regard to the cantilever A, which for clearness is shown be-

THE PERCENTAGE OF HITS IN WARFARE.

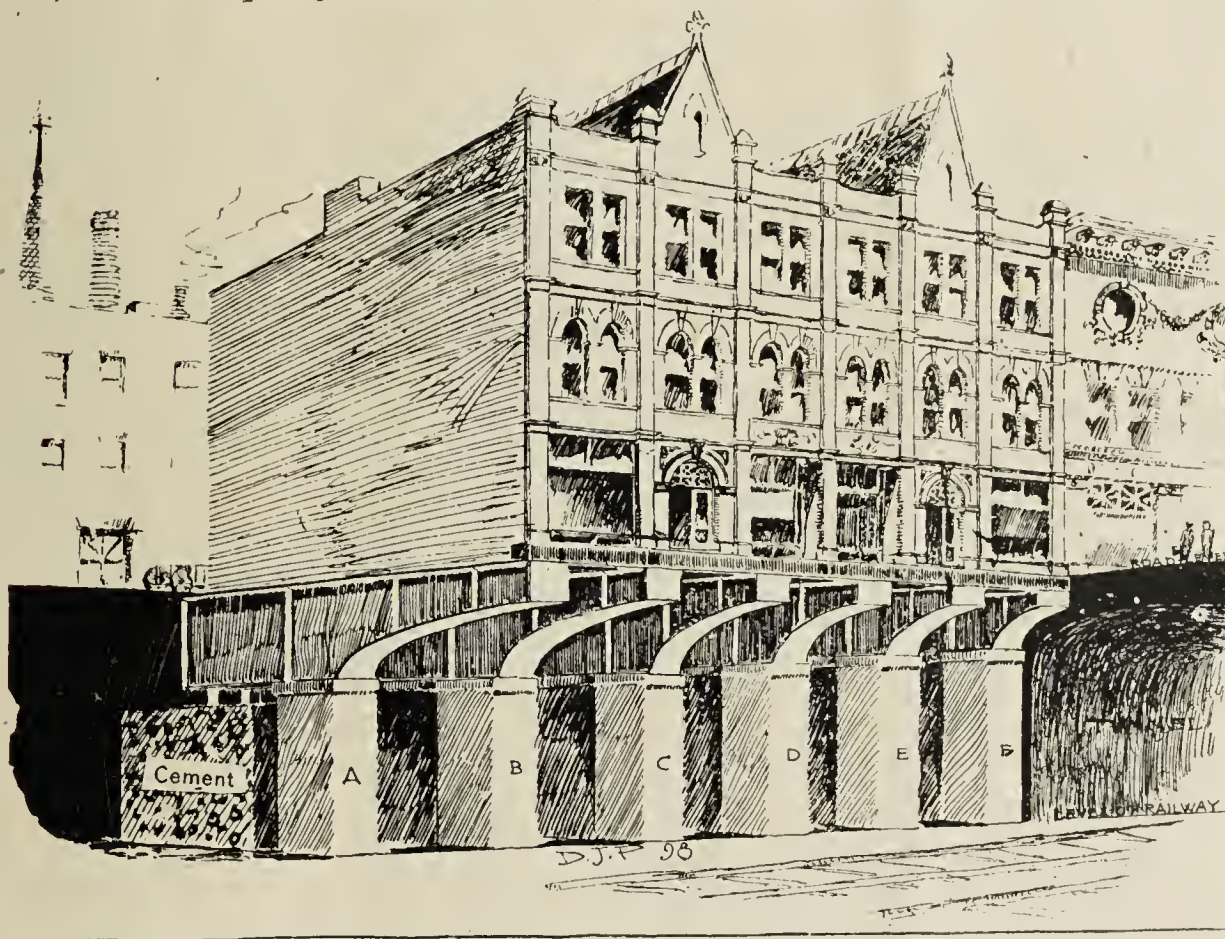
Foreign military critics at the seat of war have all spoken in high terms of the marksmanship of American gunners, and, in view of the special training which they received in the months preceding the outbreak of hostilities and their subsequent practice in the frequent bombardments of Spanish forts, it may safely be said that the work of our gunners in the naval battle of Santiago represented the best results that can be obtained with modern high-powered rifles.

With this fact in view, it is startling, and, to the enthusiastic admirer of the modern weapon, somewhat discouraging, to observe what a very small percentage of the shots that were fired, even on our side, hit the mark—not more, in fact, than about three per cent. This, apparently, is the best result that can be expected in the heat, smoke and confusion of an artillery duel at sea.

Until a more thorough examination of the Spanish ships has been made and the full returns of ammunition expended have been published, it will be impossible to determine the exact proportion of hits to misses; but sufficient has been made known by official reports and the observation of trustworthy observers on the spot to show that the figure we have quoted is not very far from the mark.

The number of shot holes counted on the four cruisers as they lay upon the beach immediately after the fight was one hundred and thirty-one, distributed as follows: The "Oquendo," sixty-six; the "Teresa," thirty-three; the "Vizcaya," twenty-four; and the "Christobal Colon," eight. As the vessels were submerged somewhat below their normal draught, it is possible that some hits in the neighborhood of the waterline could not be counted. Waterline hits, however, are not likely to be numerous, and if we suppose that about a score of hits were made that could not be counted, we get a total of, say one hundred and fifty for all four vessels. The very low freeboard and shorter length of the destroyers would render them difficult to hit, and they were so speedily sunk as to be only a short time under fire. We will assume, however, that sixty hits were made upon the two boats. This would bring the total number made on one side up to one hundred and eighty.

As regards the number of shells fired, we are informed by an officer who took part in the fight that the total of all shells, big and little, was six thousand. This agrees very well with the statement in the official



SOLUTION OF A PROBLEM IN BUILDING FOUNDATIONS.

age, rendered almost valueless because the tunnel of the Great Western Railway passed under the whole of the frontage, and that so near the surface as to preclude the use of cross-girders. Various architects and engineers had attempted to solve the knotty question of the utilization of the land, but none of the many plans submitted would the engineers of the railway company accept, Mr. Ingles, the engineer of the company, laying it down as a sine qua non that not the slightest weight should rest upon the tunnel. To meet this difficulty, Mr. Ralph Heaton, the architect engaged, has devised a system of cantilevers, as illustrated, to support the three-story erection of warehouses and offices designed to cover the space. The building from front to back is 44 ft. deep. At the A cantilever the building overhangs the tun-

low the roadway, while, as a matter of fact, it will be some two ft. above the footpath; and from it will really be "suspended" the paved carriage-way that leads to the rear of the building. By this ingenious device will at last be utilized a site which has long been a puzzle to many. The large cantilevers are at present being placed in position, and when once the ground line is reached and the mystery of the foundations covered in the curious features of the building will be entirely lost to sight.—*The California Architect and Building News*.

ON SALE.—"The Hydraulic Index of the Chatelier Formulas," by S. B. Newberry; and "The Commercial Analysis of Portland Cement," by W. B. Newberry; under one cover. Ready July 10, '98. By mail 25 cents. Address, Cement and Engineering News, 161 La Salle Street, Chicago.

report of Captain Evans, of the "Iowa," which credits this ship with having fired 1,473 rounds. Accepting the estimates of 180 hits and 6,000 rounds as correct, we find that the proportion of hits was only three per cent.

The disparity is largely explained by the fact that the dense volumes of smoke, both from our own and the Spanish guns, prevented accurate shooting by obscuring the mark during the greater part of the action.

There is an important lesson to be learned, however, from these figures; for if only three per cent of the shots reach the mark, the heavy 12 and 13-inch guns, which fire only once in three or four minutes, are at a great disadvantage as compared with the smaller quick-firing weapons. On the basis of three successful shots in a hundred, these big weapons are likely to be the better part of an hour at work before they land a successful shell on the enemy. This is actually proved by the fact that apparently only two or three of the biggest shells struck the Spanish ships, although the "Iowa" alone fired thirty-one 12-inch shells with charges, and the "Oregon," "Indiana," and "Texas" were using their 12 and 13-inch guns throughout the fight.

Furthermore, it is noticed that the number of hits for each type of gun

is in proportion to its caliber, the 8-inch doing good execution, the 4 and 5-inch rapid-fire guns even better, and by far the largest number of hits being due to the 6-pounders, of which a very powerful battery was carried by the several ships. The results are a strong indorsement of the rapid-fire gun, and they emphasize the necessity of increasing, by all possible means, the rapidity of fire of the larger guns on our battleships.

It is a question if the 12-inch gun can be handled much more rapidly than it is in some of the navies of the world, and if we wish to secure greatly increased rapidity of fire, it can only be done by reducing the weight of the larger guns. Germany has apparently already grasped this truth, for her new battleship will carry no guns of a caliber greater than 9.45 inches. The small bore is compensated by the high velocity and energy of the projectile, the penetration of the weapon being nearly 26 inches of steel, or about the same as our 12-inch gun. Yet the German gun weighs only about 22 tons, against 45 tons for the 12-inch rifle, and it is a rapid-fire weapon in addition.

The 10-inch, 30-ton wire gun now being tested by the United States government is a more powerful weapon than the 13-inch, 60-ton gun of the navy, and if it is fitted with the

most recent rapid-fire devices both in mounting and breech mechanism, it will be a vastly more efficient weapon and would form an ideal gun for our new 18-knot battleships. There are 8-inch rapid-fire guns afloat that fire four shots a minute to the one shot a minute rate of the 8-inch slow firers of the "Brooklyn" or "Indiana." We should retain the 8-inch gun, but the 3 per cent. results at Santiago teach us that we should make it a rapid-firer. Two such guns on each broadside would deliver twice the number of shells that can be thrown from the eight 8-inch guns on the "Indiana."

With four 10-inch, wire, semi-rapid-firers, four 8-inch rapid-firers, and six 6-inch rapid-firers, our new 18-knot battleships would be the most powerfully armed vessels of their day. But whatever may be the armament, Santiago teaches us that rapidity of fire should be made the supreme consideration. *Scientific American.*

The Hoosier Cement Co., Clark county, Indiana, incorporated. Capital \$35,000. John H. McQuiddy, Emmett Cuddy and August H. Gray.

The Salina Cement Company's entire plant at Quanah, Tex., was destroyed by fire Sept. 14. Loss \$4,000; no insurance.

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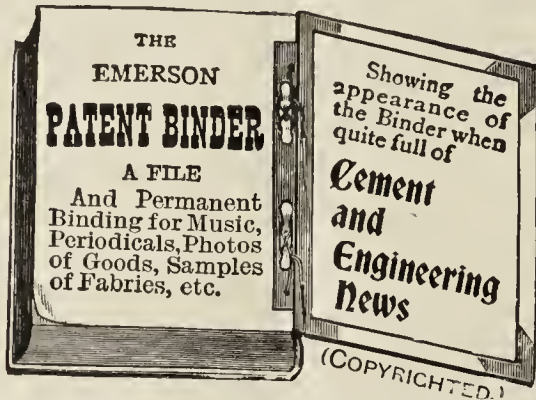
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CEMENT

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ENGINEERING NEWS



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President of The Western Society of Engineers.

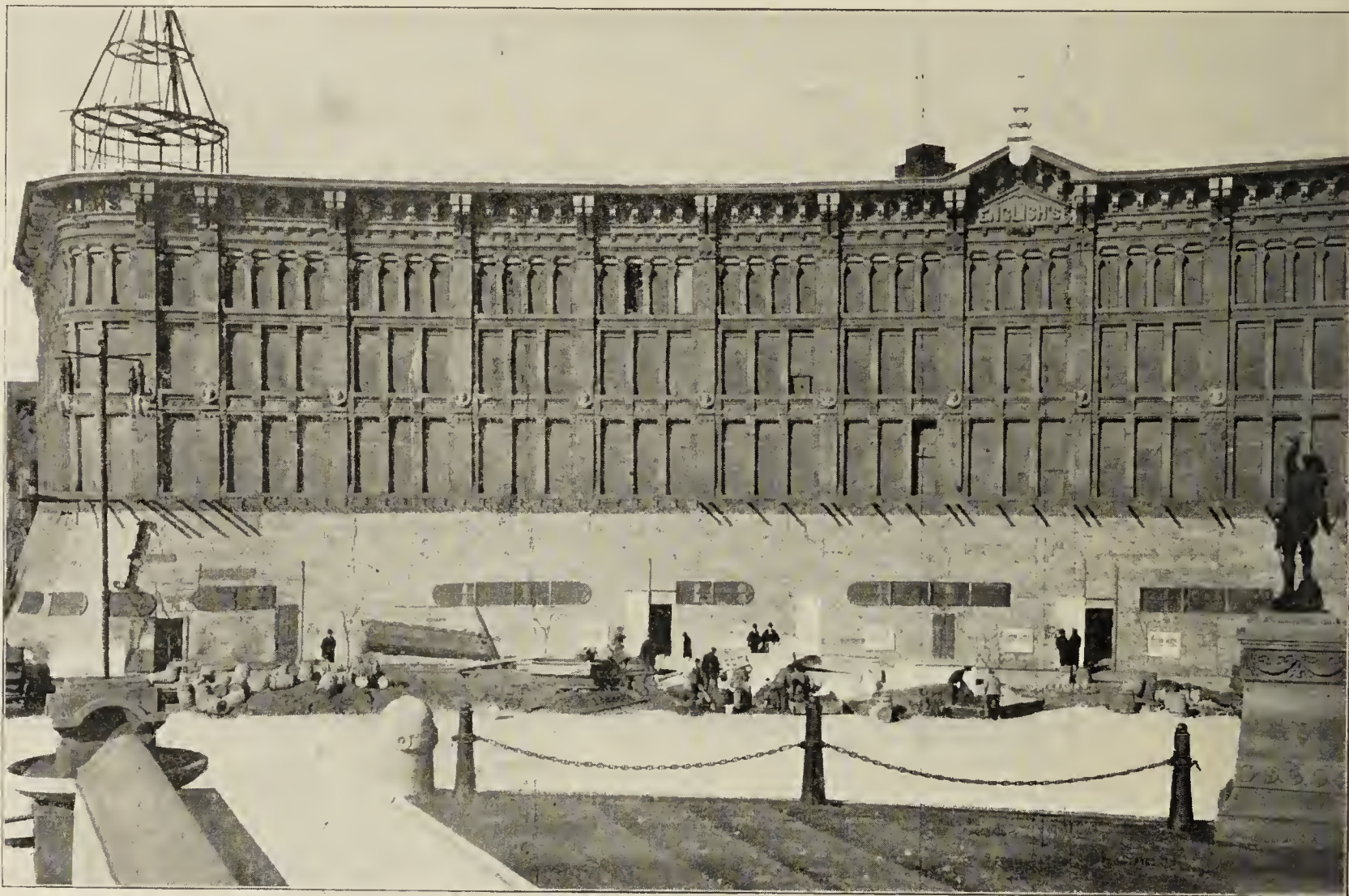
CEMENT FLOOR AND ROOF CONSTRUCTION.

The William E. English hotel and theater building at Indianapolis, and the New Academy building at St. Mary's, Ind., which we illustrate in this issue, have both adopted a concrete floor and roof construction after the plans of D. A. Bohler & Son, architects, Indianapolis, Ind. The roof and floor construction in the New Academy building covers an area of 119,000 square feet, while in the English hotel and theater building has 66,700 square feet of concrete roof and floor construction. The auditorium inclines towards the stage

four parts of washed gravel. The top coating, which is an inch thick, was made of one part of Lagerdorfer cement to one part of sand carefully troweled down. In this concrete for the reception of the theater chairs creosoted wooden strips were laid to which the chairs were fastened.

The English hotel floors, including the roof, were laid in a somewhat different manner, they being built of I-beams, over which were laid corrugated plates. These plates had wires drawn through every 3 inches, thus forming a key for the concrete. The concrete for these floors was made in proportion of one part Lagerdorfer cement, two parts of sand and four

forated with a ragged hole allowing the burr to extend upward, thus forming a connection between the corrugated plate and the concrete. The iron beams under the plates were set a span of about four feet and the concrete over these plates was made four inches mixed in the floor only, one part of Portland cement, two parts of sand and five parts of clean cinders. The strength of this floor did not show up as well under the test as the floor at the English hotel, but showed evidence of weakness, and actually broke under 600 pounds to the square foot, loaded in the center.



THE WILLIAM E. ENGLISH HOTEL AND THEATER BUILDING.

66,700 square feet of roof and floors constructed of Lagerdorfer Portland Cement.

E. A. Bohler & Son, Architects, Indianapolis, Ind.

Julius Keller, Artificial Stone Contractor, Indianapolis, Ind.

and being of concrete it is possible to turn on the hose and thoroughly wash down all impurities to the front of the stage where the water is carried off into city sewers. The following data explains the details of construction for both buildings.

The floor in the English hotel was constructed of 10 inch I-beams, spaced 4 feet apart, arched between with 9 inches of brick and the entire covered with 4 inches of Portland cement concrete, the top of which was finished and is used for the floor, no other surface being used.

The concrete for the theater was mixed one part of Lagerdorfer cement, two parts of washed sand and

parts of fine broken stone.

On the fourteenth day test this floor sustained a load of 500 pounds to the square foot loaded in the center, and the floor broke under a load of about 750 pounds to the square foot. The break was in the center and directly through the concrete and the corrugated plate, the break being clean without ragged edges. We have not since made any tests on the floors and certainly believe that they are capable of sustaining, to the present time, what was after a fourteenth day test a breaking way. The floors for the Academy building at St. Mary's were built of I-beams, corrugated plates. These plates were per-

WANTED--Position as manager or superintendent of Portland cement; experienced. Would like to erect new works. Address "Superintendent," care CEMENT AND ENGINEERING NEWS, Chicago.

A GOOD INVESTMENT.--Portland Cement Mill (new) and 15 acres of land for sale at Baltimore, Md. Price in the fee \$40,000. Address "Cement" P. O. Box 581, Baltimore, Md.

POSITION WANTED--By a cement chemist. Best references furnished; late with A No. 1 company. Address, "Chemist," care CEMENT AND ENGINEERING NEWS, Chicago, Ill.

SPECIFICATIONS FOR THE CONSTRUCTION OF CEMENT SIDEWALKS AND CURBS, WHITTIER, CALIFORNIA.

Cement curbing and sidewalk—Cement curbing shall be six inches wide on top, ten inches wide on the bottom, and sixteen inches deep, with a bevel of one-quarter inch on top. It shall be made of a concrete of the proportions hereinafter specified, and a finishing coat one-half inch thick on top and face to a depth of ten inches. The face of the curb shall be cut over before the application of the finishing coat. The upper outer edge shall be dressed to a round corner, and the surface and outer face

smoothly polished and marked off in blocks three feet square. The cement shall be of brands approved by the superintendent of streets. The sand and gravel shall be clean and sharp and free from dirt or loam. The concrete shall consist of one part by measure of cement to six parts of sand and gravel, to be thoroughly mixed dry, and then enough water added to make a stiff mass, the cement thus prepared to be immediately placed in position in the curbing or sidewalk and thoroughly tamped until the mortar flushed to the surface, the tamping to be done before any layer exceeds the depth of six inches. The concrete must be mixed in such quantities as to allow

be set by the contractor at night to mark the location of piles of rubbish, or any obstruction that might be dangerous to the public. All surplus material shall be reduced as directed by the superintendent of streets and the work left in a clean and workmanlike condition. Doubts as to the true meaning and intent of these specifications will be solved by the superintendent of streets.

The Potomac Cement works, near Shepherdstown, Md., were sold to H. W. Blunt, jr., of Washington, D. C. The plant comprises thirteen acres of land, brick cement factory, kilns, and Potomac river right.



NEW ACADEMY BUILDING, ST. MARY'S IND.

Containing 119,000 square feet of concrete floors and roof.

D. A. Bohlen & Son, Architects, Indianapolis, Ind.

Lagerdorfer Portland Cement Used.

shall be smoothed and marked off in blocks every four feet. At street intersections the curb shall be carried around the corner on the arc of a circle with a six-foot radius. Sidewalks shall be three inches thick built upon a foundation prepared as follows: All soft or spongy material is to be removed and replaced with sand or gravel, as directed by the superintendent of streets, then sprinkled and tamped or rolled, until it is thoroughly compacted. Upon the foundation thus prepared shall be spread a layer of concrete of the proportions hereinafter specified, which shall be two and one-half inches thick after being well tamped; upon this shall be spread the finishing coat one-half inch thick. The surface shall be

of its immediate use and before the cement has set. The finishing coat of the curb and sidewalk shall consist of one part of cement to one part of sand mixed dry and then enough water added so that it can be plastered on the face of the curb and sidewalk. The finishing coat shall be tinted to a dark slate color. The entire curb and sidewalk shall then be covered with earth or sand and kept covered and damp for two weeks.

General provisions.—Work shall be done to the official line and grade as shown by stakes set by the city engineer, and under the direction and to the satisfaction of the superintendent of streets. Work must be carried on so as not to obstruct the street unnecessarily. Lanterns must

WANTED—50,000 barrels of Portland cement. The City of Columbus, Ohio, will use 50,000 barrels of Portland cement in the construction of a storage dam. The bids heretofore received have all been rejected. The contract for the work and materials will be let this fall. Address Board of Public Works, Columbus, Ohio.

The Colton Portland cement works of California produced 18,000 barrels of cement in 1897. They operate rotary kilns and manufacture from limestone, rock and clay.

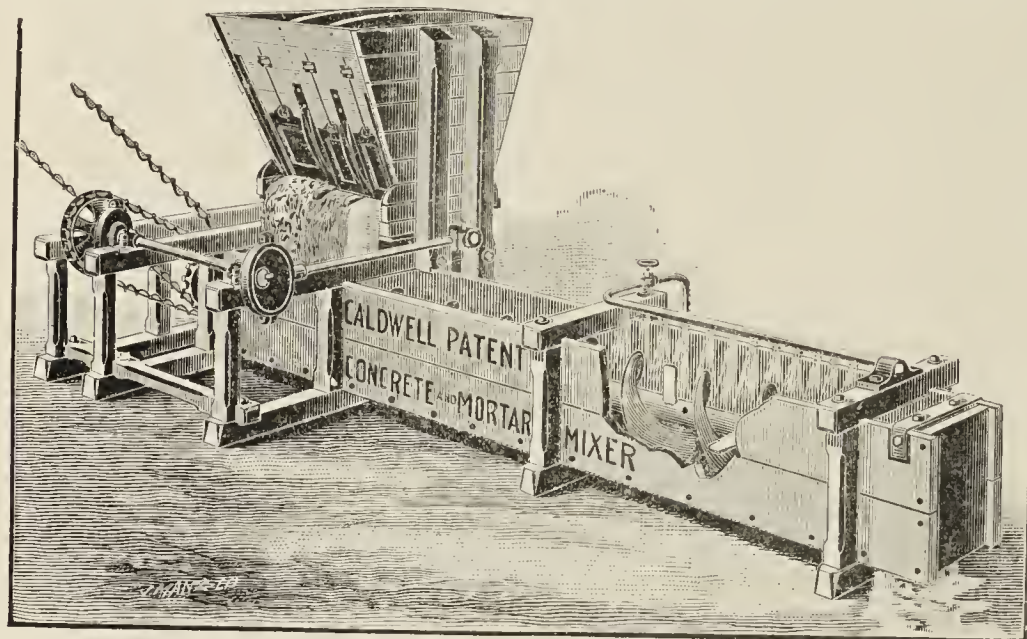
A Portland cement plant is under consideration at Owosso, Mich.

Bedford, Indiana, has a project for a Portland cement plant.

THE CALDWELL MIXER.

The increasing use of concrete work in engineering has created a demand for machinery for the mixing of the different materials. The usual type of concrete mixer operates by mixing a "batch," or certain quantity of the material, the machine being stopped to deliver one charge and take in another. The device shown above has the peculiar merit of being continuous in its operation, thus securing great capacity and economy.

The use of the Caldwell Spiral Conveyor for mixing purposes has been well known and successful for many years; the first large engineering work in which it was thus employed being the building of the concrete sub-way for the south side cable railway in Chicago. In this instance, and as well in the building of many subsequent cable roads, the machine was mounted on the car



CONCRETE AND MORTAR MIXER.

tracks, so that it followed the work as it progressed.

In addition to cable road construction the device has been extensively and successfully used in many of the engineering works where large quantities of concrete or mortar were employed, among which may be mentioned the sea-wall at Lincoln Park, Chicago, reservoir work at Nashville and Milwaukee, concrete walls of Farwell building, Chicago, and in culverts and bridge work.

The Spiral Conveyor thoroughly mixes the sand, cement and stone, and the water is added to the mixture near the delivery end of the conveyor, the result being a saving of cement and the forming of a perfect bond.

The device illustrated is novel in the addition of the proportion meter shown. This consists of a hopper with compartments for holding cement, sand and stone. Forming the bottom of the hopper is a table,

Allen & Vieths, St. Louis, cable road which, by the means of eccentrics is given a rapid reciprocating motion. Each lateral movement of the table delivers a certain amount of each ingredient to the mixer. The feed of the different kinds of material is regulated by the raising and lowering of the throat gates shown. Capacity 4 to 10 cubic yards per hour.

The Caldwell Concrete Mixer has been used in the following prominent enterprises: Fitz Simons & Connell Co., Chicago, tunnel under Chicago river, bridge work, crib construction for new Chicago water-works system. Chicago City Railroad Co., Chicago, cable road construction. North Chicago Railroad Co., Chicago, cable road construction. E. D. Smith & Son, Philadelphia, Pittsburg, Chicago and Baltimore, cable road construction. Wright, Meysenburg & Co., Chicago, cable road construction. Booth & Flynn, Pittsburg, cable road construction.

construction. J. V. Farwell, Chicago, concrete walls in the Farwell building. Sooy Smith & Co., New York and Chicago, bridge and tunnel work. City Engineer Benzenberg, Milwaukee, reservoir. Lincoln Park Commissioners, Chicago, sea wall at Lincoln park. C., B. & Q. R. R. Co., culverts and bridge work. Whitsit & Adams, Nashville, reservoir. Broadway cable system, New York. Drainage canal, Chicago.

The device is covered by patent and is manufactured and sold by H. W. Caldwell & Son Co., 127-133 West Washington street, Chicago, Illinois.

The Milwaukee Cement company of Milwaukee, Wis., entertained a party of twenty-five Chicago people at Milwaukee. Dinner at the Plankinton house and a drive around the city and a visit to the company's extensive works formed a part of the program.

CEMENT INDUSTRY IN JAPAN.

The cement industry of Japan is growing very rapidly. In 1897 the native factories turned out 600,000 barrels, of 400 pounds each, of Portland cement, and 10,000 barrels of natural hydraulic cement. The Portland cement was valued at four silver yen per barrel, or about \$2 per barrel. The English wet system and the German semi-dry system are used. The Japanese government has given great encouragement to the Portland cement industry by sending educated chemists and civil engineers to Europe to obtain technical information on the subject of Portland cement manufacture. One or more Japanese cement experts now visit Europe and attend the German Cement Manufacturers' Association meetings at least once every two years to keep abreast of the state of the art.

The cement manufacturing companies of Japan are now combining to form an association for the purpose of maintaining prices. There are ten mills in the country. At one time they did a fine business, when railway building, harbor building and other enterprises were in a state of feverish activity after the war. But they have felt the recent depression which affects all branches of business, and have come to the conclusion that their only plan is to combine for the purpose of putting an end to competition among themselves. Nine of the companies are said to have agreed to this course.

PORTLAND CEMENT WORKS ASSIGN.

John Murphy, doing business as John Murphy & Co. of Columbus, Ohio, manufacturer of Portland cement and general contractor, has filed a deed of assignment in the Probate court in favor of Florence D. Sullivan, a young business man of that city.

The assets are estimated to be \$18,000, while the debts are fully up to that figure. Mr. Murphy's plant is located on the south side of East Fifth avenue, near the railroad tracks, and consists of a large tract of land and buildings. Mr. Murphy says the plant originally cost him \$28,000. There is on hand materials in different processes of manufacture worth \$2,000. The plant is mortgaged for \$5,000.

The assignment includes all of Mr. Murphy's real and personal estate.

Clay C. Cooper, who for the past five years has been assistant managing and city editor of the *Journal* of Detroit, Mich., has resigned to accept an important position with the Michigan Portland Cement company.

CEMENT AND ENGINEERING NEWS.

(PUBLISHED MONTHLY)

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CORRESPONDENCE.

We solicit correspondence on all matters of general interest to the cement trade in all of its branches. Engineering notes, public improvements, and facts and opinions drawn from practical experience will be welcome.

THE PORTLAND CEMENT FAMINE.

During the past few months there has been a veritable cement famine in the United States. Large and important works have been delayed for months simply because sufficient cement could not be obtained, while other large projects involving its use will be carried over for the season of 1899. While prices have advanced fully 20 per cent. at the mills on new contracts even under these conditions, there has been three buyers for each barrel of cement produced. In the January issue of this paper we predicted that the output of the American Portland cement mills for the year would fall short of the domestic demand and advised dealers to close for the season's supply at the earliest possible date. This was sound advice.

There are numerous indications in sight that the season of 1899 will be a good one for the cement trade, and that the output of the American cement mills will again fall short of the legitimate demand, and that prices will be fully maintained.

Large corporations are arranging to place their orders early so as to insure of not being caught short-handed, as has been the case during the present season. At the present time contractors hesitate to bid on work calling for large quantities of

Portland cement, preferring to separate the bid so as to leave the furnishing of the cement to the principals, simply as a precaution, owing to the state of the cement market.

While Portland Cement prices have uniformly ruled high during the season there has been a veritable panic in the Louisville natural cement market, where prices have touched as low as 15c. per bbl. in bulk at the mill, shattering the heretofore existing Louisville cement trust into fragments. While natural cement has its own appropriate field of usefulness, present conditions indicate that it cannot affect the market price of Portland, since it has shown no sympathy to rise and fall with Portland cement quotations, and therefore cannot materially affect the existing Portland cement famine.

CONCRETE AGGREGATES.

The use of concrete for every kind of construction has become so general that the quality of the materials of which it is made is a matter of great importance. Specifications prepared for this purpose invariably call for broken stone, to the exclusion of other materials. I find that many persons, who have not given the subject proper consideration, contend that the compound is complete whereby stone, regardless of its quality or texture, enters into the mass. I will here state that as much care should be taken in the selection of the aggregates, stone and sand, as in that of cement. The stone should be perfectly clean and free from flour and dust. The fragments should possess angular faces and be gradu-

ated as to size. The theory that limestones contribute to the strength of the mortar with which they are mixed, and ultimately produce stronger concretes, is incorrect. The limestone will invariably produce a concrete that can be termed as tough, but never attains extreme hardness, which is essential in all constructive work. I have also found that concretes prepared from limestone aggregates are much more liable to expansion than other stones. The irregular faces and sharp edges of broken stone are not all the advantages in the composition of concrete. It is essential that the aggregates should vary in size, so as to form a wedge with each other, and thereby permit of being properly compacted by ramming. Care should be taken to exclude long, thin fragments, which invariably crush under pressure, or break in ramming the mass. The best concrete is obtained by using at least two sizes of broken stone smaller than the largest aggregate. This fact can be readily demonstrated by mixing the stone and placing it in a heap, when the resistance to ramming will be apparent. The use of one size stone is liable to produce arching, even when the presumption is that the concrete has been properly rammed. When preparing concrete I have frequently used screened gravel with equal parts of broken stone. I have found its oval surfaces pack more closely in the interstices of the stone. To sum up the matter, a variety of shapes and sizes in the aggregates are essential for the ultimate strength of concrete.

I would therefore recommend that a percentage of the stone aggregates used in concrete be proportioned into at least two sizes, under the largest aggregate.

WARNER H. JENKINS, C. E., in *Municipal Engineering*.

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France.....	374,800	1,111	273,800	1,104	5,683,873	17,863	2,367,800	8,897
Germany.....	47,782,861	163,324	45,466,540	163,437	307,074,886	1,000,509	264,658,246	892,039
All Other Europe....	1,723,432	5,399	1,587,200	5,205	12,010,000	44,069	15,112,718	46,941
British North Am....	119,350	596	96,000	422	955,575	4,500	1,182,550	5,681
Other Countries.....					411	1	5,200	67
TOTAL.....	80,641,537	266,076	87,203,310	291,791	537,567,256	1,709,010	501,920,086	1,620,888
Domestic Exports of Cements, bbis.	3,038	4,226	971	2,608	36,542	64,975	22,425	44,224

There were 3,708,335 lbs. of imported Roman and Portland cements, etc., in the United States bonded warehouses on August 31, 1898, valued at \$11,498 against 8,592,105 lbs., valued at \$25,187, in August, 1897.

Imports of asphaltum or bitumen for August, 1897, were 13,301 tons valued at \$49,511; August, 1898—6,329 tons valued at \$19,586. For eight months ending August, 1897, 97,690 tons valued at \$328,730; for eight months ending August, 1898—43,273 tons valued at \$133,214.

ARRANGEMENT OF PULLEYS, BELTS AND SHAFTING FOR THE ECONOMICAL DISTRIBUTION OF POWER.

The installation of pulleys and shafting for the distribution of power calls for a high degree of skill and calculation to eliminate waste of energy.

The continuous bending of the belts in running over the pulleys is a draft upon the prime energy that should be considered, and when belts are numerous the aggregate of power consumed will be considerable.

The stiffer the belt and sharper the bend the greater the power con-

in the illustration in changing from Fig. 1 to Fig. 2.

Here we have a line shaft, from which belts run to countershafts on either side. In Fig. 1 the arrangement is such as to throw a very heavy pressure on journals "a" and "b" which in consequence makes considerable friction at these points. Fig. 2 is precisely like Fig. 1, except that the countershafts "A" and "B" have been turned end for end. Neither the machines to be driven, nor the pulleys on the line shaft have been moved, yet the belt pulls balance each other, and the pressure on the journals "a" and "b," due to this

also increases the speed of the rubbing surface, it follows that the proper way is to increase the pulley diameter. As belt speeds may advantageously be increased up to 5,000 or 6,000 feet per minute, there is usually no limit to the increase of pulley diameter except convenience and space. Referring again to Figs. 1 and 2, it will be seen that about one-half of the friction due to belt pull was eliminated by the change made—that on the line shaft being reduced to almost nothing, and that on the countershafts remaining the same. If the arrangement remains as in Fig. 1, with the pulley diame-

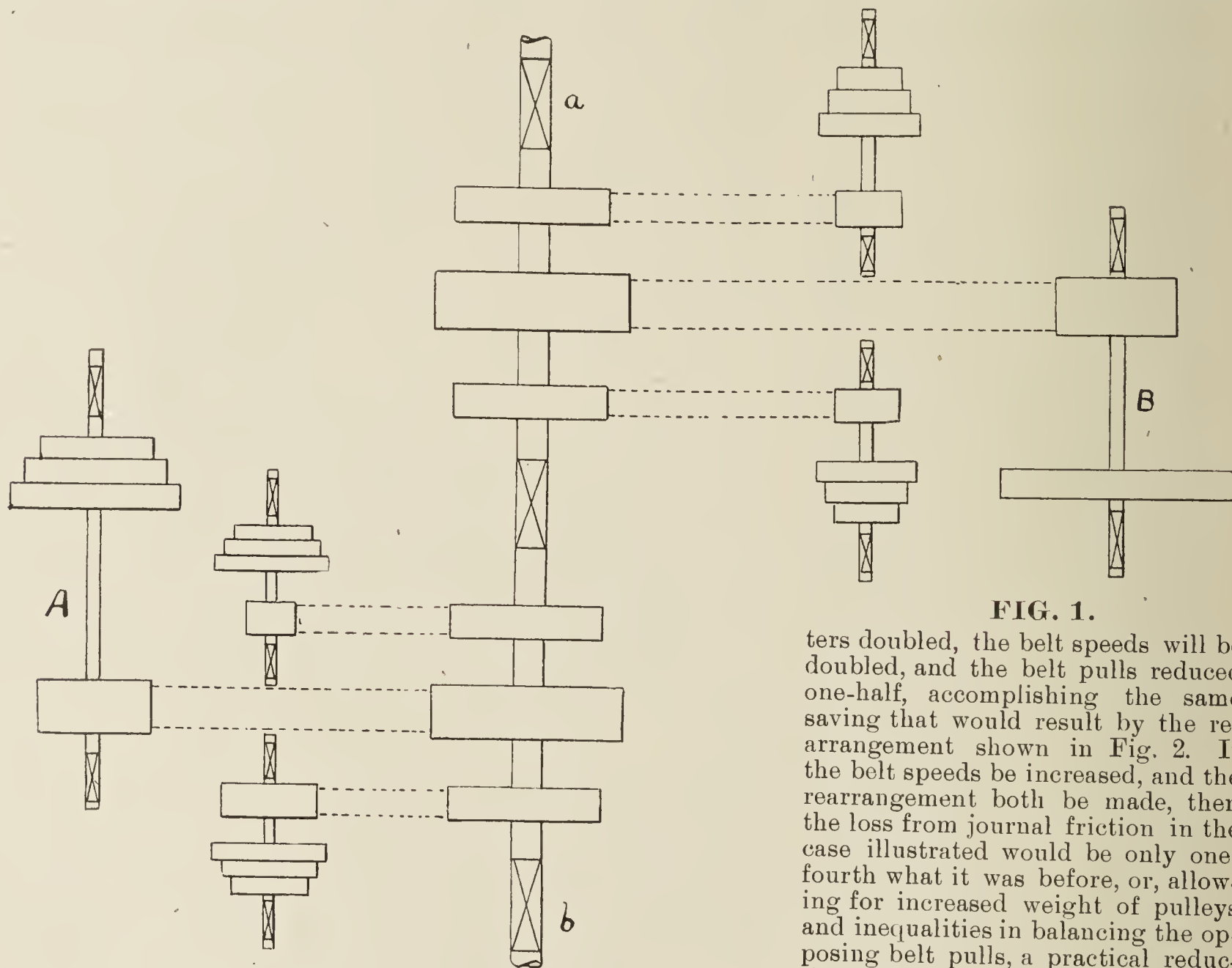


FIG. 1.

ters doubled, the belt speeds will be doubled, and the belt pulls reduced one-half, accomplishing the same saving that would result by the rearrangement shown in Fig. 2. If the belt speeds be increased, and the rearrangement both be made, then the loss from journal friction in the case illustrated would be only one-fourth what it was before, or, allowing for increased weight of pulleys and inequalities in balancing the opposing belt pulls, a practical reduction to one-third. As decreasing the pull of the belts, or balancing those pulls, decreases the tendency to bend the shaft, a lighter shaft can usually be used, thereby decreasing the speed of the rubbing or friction surface.

sumed. It follows that a wide and thin belt is preferable to a thick and narrow belt, while belts run on pulleys of large diameter are more economical since the bend of the belt is less sharp.

The friction of the bearings due to the pressure on the journals and speed of the rubbing surface is of greater importance as a source of wasted energy, and is produced by the pull of the belts and weight of the shafting.

The pressure on the bearings may be reduced by arranging the pull in different and opposite directions so as to balance each other, as shown

cause, has been reduced to almost nothing. While such glaring faults as are illustrated in Fig. 1 are not common, there are very few manufacturing establishments in which some change of this character cannot be made to the manifest saving in fuel.

We can transmit a given power by a heavy pull moving slowly, or by a light pull moving rapidly. If we desire to reduce friction by reducing the belt pull, we must increase the belt speed either by increasing the diameter of the pulleys or by increasing the revolutions of the shaft. As increasing the speed of the shaft

The Banner Cement company of Clark county, Indiana. Head office Masonic Temple, Chicago, has commenced grinding a high grade of cement. It is superior to any natural cement produced in the Louisville cement belt, and is sold upon honor.

A new Portland cement plant is projected near Columbus, Ohio, by Eastern capitalists.

A NEW PORTLAND CEMENT PLANT.

The new plant of the Portland Cement Company of Utah, of Salt Lake City, has been completed on the site of the old plant, which was destroyed by fire May 31 of the present year.

The rotary kiln system has been adopted, the present capacity of 60 barrels per day to be increased to 120 barrels per day in the near future. Messrs. Lathbury and Spackman of Philadelphia prepared the plans and specifications and are the engineers of erection.

The latest and the most improved machinery and equipment only have

for the branch mint at Denver, 6,000 barrels; for the Twin Lakes reservoir, near Leadville, 3,000 barrels; orders ahead for Montana and the Pacific coast, besides local orders sufficient to take care of the output well into 1899. A noteworthy feature of the plant is the well-equipped laboratory, occupying three rooms, more complete and convenient than generally found in the West, housed in a neat brick building, together with the business office. The main building is of structural steel and throughout there is slight opportunity afforded for damage by another fire. The company is a California corpor-

Alkali Company.

The buildings are to be four in number of brick and steel construction and the latest machinery will be introduced for the manufacture of Portland cement from the waste product of the alkali works. The cement will be burned in rotary kilns with pulverized coal as a fuel and the works will have a capacity of 500 bbls. per day.

They have also closed a contract for the reconstruction of the old Portland cement company located at Marlbank, Ontario, Canada, and formerly known as the London Portland Cement Company. The material is

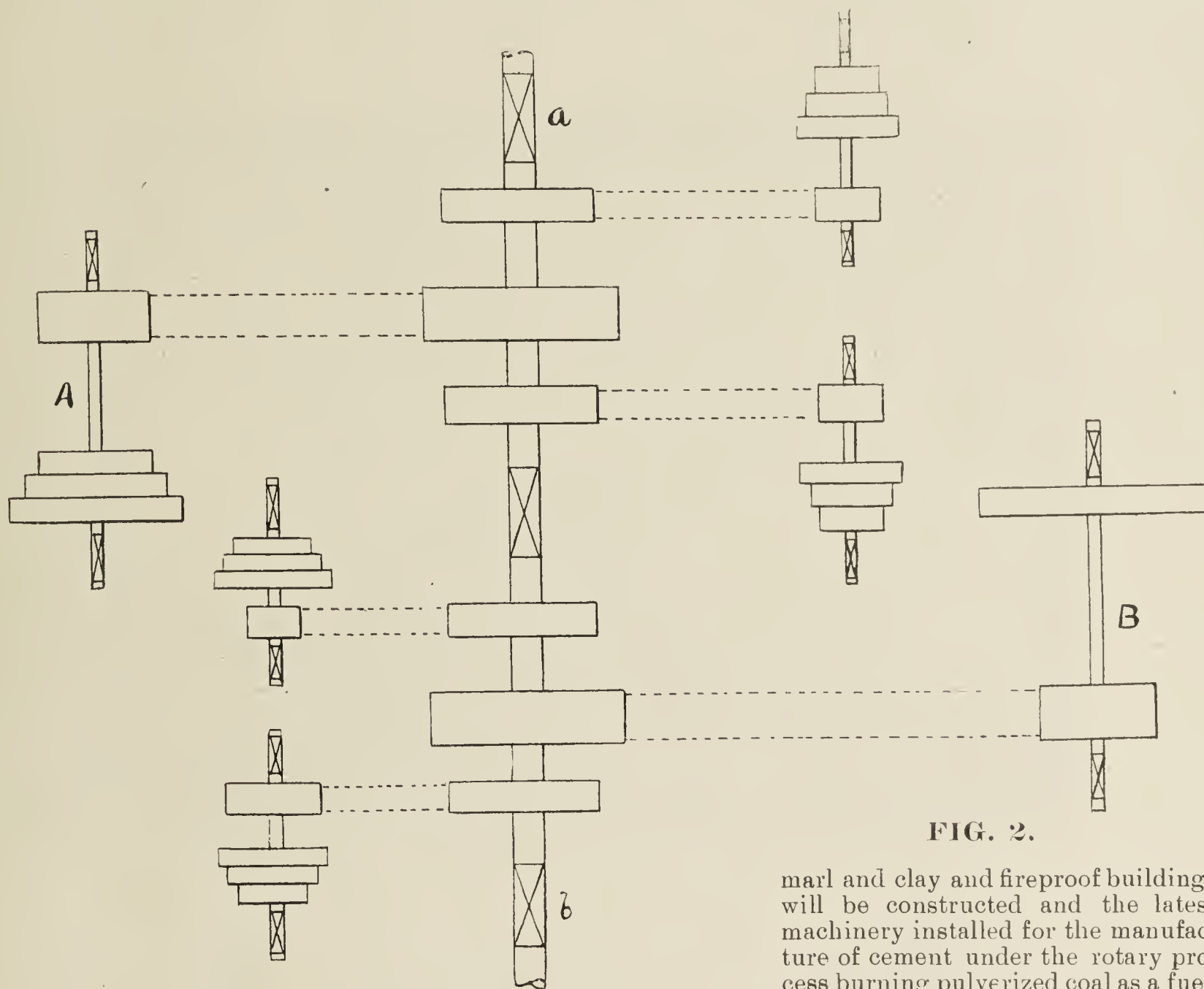


FIG. 2.

been installed, and it is in every sense a model plant.

Electric power will be used, supplied by the Union Light and Power company from Ogden canyon, forty-five miles distant.

The raw material is an argillaceous limestone, quarried in Parleys canyon, eight miles from Salt Lake, on the line of the Utah Central branch of the Rio Grande Western. This has been found an excellent rock for the purpose, and superior Portland cement is the resultant product, the demand for which is steadily growing. The company has the contract

ation, capitalization \$75,000, shares \$100, with principal office in San Francisco, though the bulk of the stock is owned in England. The officers are: Jesse W. Lilienthal, president; James R. Moorman, vice-president; Albert Raymond, secretary; Thomas C. Cairns, general manager.

NEW CEMENT WORKS UNDER WAY.

Messrs. Lathbury & Spackman have just closed contracts for the design and construction of a Portland cement plant to be located at Wyandotte, Michigan, for the Michigan

marl and clay and fireproof buildings will be constructed and the latest machinery installed for the manufacture of cement under the rotary process burning pulverized coal as a fuel.

The works are to be constructed with a view to having an ultimate capacity of 1,000 bbls. per day and machinery installed for an initial capacity of about 400 bbls.

The marl deposits of this property are large in extent of the finest quality. The material is entirely free from vegetable matter and is almost a pure white chalk. It underlays the flat lands and exists in the lake bottoms of a chain of lakes running through this region.

Advertise

IN THE
CEMENT &
ENGINEERING NEWS

CONCRETE CONSTRUCTION BY AMERICAN RAILWAY COMPANIES.

European railway corporations have for years been using concrete construction in the permanent betterment of their right-of-way. Concrete in combination with steel being largely used for bridges spanning the largest rivers as well as for culverts, piers, abutments, arches and culverts where concrete alone has been utilized. Considering durability, economy and the rapidity of construction no material answers as well as Portland cement concrete.

American railways corporations are taking very kindly to concrete construction and find it meets every

demand for Portland cement from year to year by our railway companies. The storage of the Portland cement supply during the present season has prevented large improvements from being pushed forward in concrete simply because the cement could not be had at figure heretofore prevailing. Present appearances indicate that the railway corporations will make large orders and place them earlier than usual to insure their orders being honored. This will enable the mills to grind on orders and shorten the usual period of shutting down.

CALIFORNIA ASPHALTUM.

The two principal asphalt mines in

to the seashore, where it is further prepared for shipment. On this new plant at that point the Alcatraz company have expended over \$500,000, and by the value of its properties and the amount of its investments it is one of the largest, if not the very largest asphalt company in America. The Alcatraz is the parent stem, but there are branch companies in Los Angeles, New York and other large eastern cities, and in London, England. The production of asphalt in the state for 1897 was 22,697 tons valued at \$404,350.

The Coldwater Cement company has transferred its stock to the Michigan Portland Cement Co. A party of twelve Detroit capitalists visited



ILLINOIS CENTRAL RAILROAD'S CONCRETE ARCH, JACKSON, MISS.

D. Sloan, Chief Engineer.

H. W. Parkhurst, Engineer of Bridges, etc.

13-foot arch, 60 feet long.

Lagerdorfer Portland Used.

requirement for the permanent improvement of their right-of-way. The Illinois Central Railway, operating a line from Sioux City, Iowa, to New Orleans, with numerous branches, has adopted concrete in preference to stone along the entire line of its right-of-way for arches, culverts and abutments, and for this purpose has become one of the largest consumers of Portland cement in the country. We illustrate a concrete arch built by this company at Jackson, Miss., using Lagerdorfer Portland cement in this instance.

Other American railways are fast falling into line in the use of concrete for like purposes.

We look for a steady increasing

Southern California are Las Conchas and La Patera, both owned and operated by the Alcatraz company of San Francisco, of which the Alcatraz Asphalt Paving company of Los Angeles is the most important branch. Las Conchas mine is at Carpenteria, not far from the seashore, and La Patera is about 10 miles west of the city of Santa Barbara. Together they employ a large force of men at the works.

A few weeks ago the Alcatraz company started up their new big plant at Sisquoc and Alcatraz. The crude material is mined at the former place where under a new process invented by Mr. A. F. L. Bell, superintendent for the company, it is liquified and piped

Coldwater to inspect the property and the big buildings that are nearly completed. Among them were S. W. Hayes, Butler Ives, Ellwood T. Hance and Edward H. Parker. The Michigan Portland Cement company of Detroit, Mich., has a capital of \$2,500,000.

The Ashland Lime, Salt and Cement company of Ashland, Wis., have purchased an extensive dock frontage for shipping their product. Consideration, \$12,000.

ON SALE.—“The Hydraulic Index of the Chatelier Formulas,” by S. B. Newberry; and “The Commercial Analysis of Portland Cement,” by W. B. Newberry; under one cover. Ready July 10, '98. By mail 25 cents. Address, Cement and Engineering News, 161 La Salle Street, Chicago.

THE PROTECTION OF METAL WORK IN CONCRETE.

A discussion under this head has been running through several issues of the *Engineering Record*, from which we abstract the following:

To the Editor:

SIR: Can you explain why the steel I-beams which are entirely embedded in concrete in the construction of the foundations of tall buildings are painted? I asked the superintendent of a building now being erected just off lower Broadway, and he told me very emphatically that they were painting them "to keep them from rusting." The paint they were using was a black paint, probably an asphaltic preparation, though this is immaterial to the point I wish to bring out.

If the steel were to be cleaned and not painted at all it would probably be much better and more permanently protected. The adhesion of the concrete to clean steel is shown by tests which have been made to be greater than the tensile strength of the concrete. Some instances are noted of iron and steel having been embedded in concrete for twenty years, and at the end of that time found in a state of perfect preservation.

On the other hand, if the beams are painted the adhesion can be no greater than that of the paint to the metal and very likely less. In either case it is so small that it has the effect of constructing vertical cleavage planes in the courses of the foundation coincident with the plane of the paint, thus preventing the steel and concrete from acting as one mass, and defeating one of the chief advantages of that style of foundation construction.

If the beams were cleaned and not painted, the adhesion would make each course one solid mass, giving a construction much more reliable and durable, and also stronger, since the steel and concrete would then form a composite beam, which is considerably stronger than the steel beam alone, together with saving the cost of painting. ALBERT W. BUEL.

Prof. A. H. Sabin, Assoc. M. Am. Soc. C. E., replying says: "The principal point raised by Mr. Buel, which is that cement may be so firmly bonded to a metal surface as to form a compound structure having as much strength as the sum of the two, I do not desire to discuss further than to say that this implies thorough cleaning of the metal by the sandblast or some other equally efficient method, which is seldom done, and that there will be no such advantage in applying the cement to a surface of loose rust or even closely

adherent scale, for it is generally agreed that the latter will come off in time. A rigid body like cement will leave a crevice when it leaves the metal. On the other hand, if the steel is well painted it is covered with an elastic film which will afford considerable protection. Long experience shows much good results from painting on an ordinary surface. Cement undoubtedly protects metal when used in a dry place, and samples may be shown to prove this, on the other hand samples may also be found showing the contrary. The current practice of painting such metal surfaces is a good one, and care should be taken in painting and more paint used on such work."

To the Editor:

SIR—Prof. Sabin's reply to my query, in your issue of August 27, is so much at variance with all the opinions on the subject that have come to my notice, and several statements regarding concrete and cement are so misleading, that I have made a special research of this subject, with the following results:

First, as to the adhesion of Portland cement concrete to ordinary metal surfaces: Prof. Bauschinger found the adhesion of Portland cement concrete to iron or steel to be from 570 to 670 pounds per square inch. Mr. Robert Moore found that anchor bolts set in cement had a greater holding strength than when set in lead or sulphur. The anchor bolts for some of the elevated railroad work were delivered painted, but the engineer in charge required the contractor to burn off before setting the bolts.

I have a list of 75 concrete-steel Monier, Melan and Wunsch bridges built in Europe. A number of these spans are from 75 to 150 feet. Thirty-two spans of Melan concrete-steel arch bridges have been built in America, the longest span being 125 feet in the clear. This construction depends fundamentally on the adhesion of concrete to steel. The metal is cleaned, but without any such extraordinary and expensive means as by the sand blast; and is invariably used without paint. A number of arches, up to 77 feet span, built and tested to destruction by the Austrian Society of Engineers, entirely confirm this practice. As a matter of fact, the evidence shows that the concrete-steel foundations, or many of them, have been proportioned on the composite theory, and that of the adhesion of concrete to steel.

Mr. C. T. Purdy says, writing on this subject: "This has been frequently discussed among engineers, and, led by a study of the behavior of similar foundations already under maximum loads, they arrived at these

conclusions. * * * But, as a matter of fact, the concrete acts to some extent as a beam, * * * and consequently the binding effect of the iron and concrete, taken together, causes the foundations as a whole to have a moment of resistance much larger than the sum of the resistance of the several layers. A number of foundations are now in, based on a similar line of reasoning, and none yet have failed in the least degree."

One professor calculated that the beams in the foundations of the Fair Building in Chicago were under stresses of 29,375, 32,200, 60,000 and 41,900 pounds per square inch respectively, in different courses. He neglected the concrete and its adhesion to the beams. Mr. W. M. Clapp, the engineer for the architects, Messrs. Jenney & Mundie, replying, said: "The Portland cement concrete holds the beams in the different layers in such a way that any motion is as impossible as it would be between the top and bottom chords of a truss." The concrete-steel foundations built by Mr. E. L. Ransome rely entirely for stability on the composite action of steel and concrete, and the tests of a Ransome slab made at the Massachusetts Institute of Technology, and published in *The Engineering Record*, entirely confirm the accepted theory. Therefore, if these foundations are proportioned as composite structures, as the evidence seems to indicate, and then the beams are painted, in effect lubricating them and preventing the bond, the effect is somewhat analogous to leaving out most of the flange rivets of a girder, and just about as good practice.

Now, to come to the question of preservation of steel from rust when imbedded in concrete. Prof. Sabin says: "A rigid body like cement will leave a crevice when it leaves the metal." In view of the demonstrated fact that the adhesion of concrete to steel exceeds the cohesion of the concrete, rupture will not occur until the stress exceeds the tensile strength of the concrete, and will then occur in the concrete, and generally not between the concrete and the metal, thus leaving the metal covered and protected. This must stand until the advantages of painting can advance tests and experiments to refute those set forth above. Incidentally, the reference to cement or concrete as a "rigid body" is likely to be misleading, and if construed as inelastic it has been termed unparadonable.

Again, Prof. Sabin refers to cement as "a porous substance." Mr. Attilio Rella, a prominent engineer and expert on concrete, cites some 80,000-gallon wine tanks made of

concrete exclusively, in Agram, Hungary. Wine is quite an expensive fluid to put in "porous" tanks. Monier has built nearly 1,000 water and gas tanks throughout France, some 70 feet in diameter by 11 feet high. Cast iron is so porous that gas mains have to be coated to prevent excessive leakage, yet concrete is a satisfactory material for gas tanks.

Portland cement mortar is of a maximum density when the proportions of cement to sand are from 1 to 1, to 1 to $2\frac{1}{2}$, depending on the aggregates, and at its maximum density is practically impervious to water. Water can be forced through most any substance if the pressure is high enough, therefore porosity is largely a relative term. In fact, Prof. Sabin has himself pointed out distinctly the porous nature of paint coatings and therefore the desirability of using a kind of japan or varnish, baked on under a temperature of some 300 degrees Fahrenheit for several hours. The difference in quality of concrete is as great as the difference between the high grade japan baked coating and the poorest paint. Concrete can be made as porous as desired if the aggregates are selected to that end.

Mr. C. T. Purdy says in volume xxxix. of the "Transactions" of the American Society of Civil Engineers: "Good Portland cement concrete, at least two or three inches thick, is impervious to water, unless the water is under some pressure." "It has frequently been stated that there is no better conservator of iron than good Portland cement concrete." And in another place he says: "Wherever iron has been taken out of steel-concrete foundations, it has been found well preserved." Mr. J. P. Frizell says, in Volume xxvii. of the same publication: "As to the adhesion of cement to iron, it is well known that iron pipes coated with cement are laid down by the mile. These have been taken up in many places, but not because of lack of adhesion of the cement. I have taken up pipes that have been laid many years, knocked off the cement and found the iron bright as new. The cement certainly preserves the iron from rust." Mr. Fr. von Emperger writes in Volume xxxi. of the same transactions: "The writer knows of a case where iron rods were found perfectly rust free, having been imbedded in concrete below water level for 400 years. There are many devices designed on this important property, and for the protection of iron concrete is better than paint."

Mr. R. W. Lesley says, in the same place as the quotation from Mr. Purdy: "About a year ago the speaker made quite a study of con-

crete construction in buildings under several of the French systems, and in every case the iron was covered directly with the cement, without paint or varnish or anything intervening. One building is quite remarkable. It is a large brewery, seven stories high, entirely built of little iron rods surrounded with concrete." In the new Boston subway the beams were not painted but were coated with cement, probably a grout, before being imbedded in the concrete. This method was only adopted after extended investigation.

While a "very general belief" is hardly a reliable kind of evidence, as far as it goes it seems to preponderate in favor of the proposition that good Portland cement concrete is the best preservative coating for steel, when imbedded in concrete as in the concrete-steel constructions. If the engineering practice above referred to is in error it should be shown so, and if Prof. Sabin will cite the "samples" to prove that good concrete does not efficiently protect the metal, the profession will be indebted to him to a far greater extent than it already is for his most valuable experiments with paints.

ALBERT W. BUEL.

HIGH PRAISE FOR THE "CONSTITUTION OF HYDRAULIC CEMENT," BY S. B. & W. B. NEWBERRY.

"No piece of work on the chemistry of cement comparable with this by Messrs. Newberry has appeared within the last ten years, and we congratulate the authors on the sound method, well-directed industry and clear reasoning which are its characteristics."—*The Engineer*, London, Dec. 24, '97.

Copies of this work will be sent to any address on receipt of 25 cents by the CEMENT AND ENGINEERING NEWS.

The Canadian Pacific Railway Company's Portland cement works near Vancouver, B. C., has been closed for some time. Its present capacity is about 12,000 barrels per year. An English syndicate is negotiating for its purchase with the view of largely increasing its capacity. A representative of the syndicate is now on the ground assembling data for his principals. The works were built and operated by the Canadian Pacific Railway.

The attention of our readers is directed to the advertisement of Prof. J. Dunraven Young, which appears in this issue. Prof. Young is well known as a chemist of much experience in the analysis of cements, clays, limestones, etc., and was formerly in charge of the metallurgical division, chemical department, Armour Insti-

tute of Technology. Among his patrons may be named the Engineering Department Sanitary Commission and many large corporations throughout the United States.

The Peerless Portland Cement works was badly crippled by fire at 4 o'clock a. m., Oct. 6, entailing a loss of about \$40,000, with no insurance. The fire originated from one of the burning kilns, and before the fire department could get to work, the mixing room, a frame structure 125x60 feet in size, and the drying kilns, 150x90 feet, were totally destroyed. In the mixing room was \$25,000 worth of machinery, a portion of which was but slightly damaged. The company started about three years since with a \$20,000 plant but had recently been reorganized and capitalized at \$250,000. The works had been increased in size until the cost reached \$200,000, and had only a few weeks since started up again. Owing to delay in securing a satisfactory rating, no insurance had been placed, it being the intention to have the policies written this month. About 100 men were thrown out of employment until the burned portion can be rebuilt. The officers of the company are J. E. Saxton, president, and Lee K. Forsythe, secretary and treasurer, both of Union City, Mich., and Robert M. Wood of Chicago, vice-president. The loss falls upon them and a few other stockholders in Chicago.

To Dealers in Cement:

We are the original manufacturers of Sandusky Portland Cement, and by reason of the uniform quality and excellence of our product (the United States government being one of our customers) have built up a name and reputation for SANDUSKY PORTLAND CEMENT,

"MEDUSA BRAND."

We advise you that the product of the Art Portland Cement company of Sandusky, Ohio, is not manufactured by us, and request that when you handle Sandusky Portland Cement and wish the product from our mills for your customers you will handle only the MEDUSA BRAND.

THE SANDUSKY PORTLAND CEMENT COMPANY.

P. H. Jackson & Co. of San Francisco, California, have placed on the market Jackson's patent combined artificial stone sidewalk and galvanized corrugated steel roof vault four inches thick over all, with a carrying capacity of over 2,000 pounds per square foot. While the cost does not exceed brick or concrete arches it is particularly adapted to vault areas that will not permit deep excavation.

CEMENT FROM SEWAGE SLUDGE.

A fair cement possessing some of the properties of Portland cement has been made from sewage sludge in England by Gen. Scott, Royal Engineer, and was developed by the lime process of sewage treatment.

In accordance with this process, a small quantity of lime (from 15 to 23 grains per gallon) in a fine state of subdivision is added to the sewage water, and as this substance becomes mixed with the water in the sewer it gives rise to a copious precipitate, consisting mainly of carbonate of lime, together with a little phosphate of lime. The sewage is then allowed to pass into tanks where the flow is arrested, and the precipitate slowly sinks to the bottom, and in so doing it entangles and carries down with it all the suspended impurities, leaving the supernatant water thoroughly clarified, and in a fit condition to be discharged into rivers of large volume. The sewage sludge or mud which remains at the bottom of the tank, when this clear effluent has been drawn off, is dried either on hot floors or by mechanical pressure, or other suitable means, and when sufficiently dried it is burnt in draught kilns of special construction with small quantities of interstratified fuel.

Character of Sewage Cement.—Gen. Scott was able to produce in this way a cement which had approximately the composition of Portland cement, because the detritus and clayey matters washed from the surface of the roads, and the ash of the faecal, and other organic substances always present in sewage water furnished the amount of silica, alumina and iron needed for the cement. In dry weather it became necessary in certain cases to add a small quantity of clay to the sewage water along with the lime, this addition of clay aids in the clarification of the sewage, and need rarely exceed a few grains in the gallon. This plan of dealing with sewage had manifest advantages, as it enabled municipal authorities to get rid of the sludge without expense, and lime is well known to be the cheapest and best precipitating agent. It was found in practice that from 1 to $1\frac{1}{2}$ tons of quicklime were needed for the treatment of one million gallons of sewage water, or say for the daily volume of sewage produced by a population of 25,000 persons. If the cost of lime be taken at 15s per ton, this implies a cost of 9d per diem per thousand inhabitants. From each ton of lime used with sewage of average composition there will result 30 tons of wet sludge or 3 tons of dry sludge. This sludge when calcined will yield about $1\frac{1}{2}$ tons of

of the sewage water, and the impurities present therein. By carrying out the calcination at a lower temperature, the sludge may be converted into hydraulic lime, or a lime suitable for agricultural use. It was found by experiment that for each ton of lime introduced into the sewers, 45 bushels of good agricultural lime valued by Dr. Voelcker at 1s per bushel, were obtained. The cement made at Burnley which was calcined at a high temperature, though it fluctuated somewhat widely in composition, owing to the varying quantities of detritus carried into the sewers during rainy weather, commanded a ready sale, and showed a fair tensile strength.

GERMAN STANDARDS FOR THE UNIFORM DELIVERY AND TESTING OF PORTLAND CEMENT.

Explanation of what is understood by Portland Cement.—Portland cement is a material resulting from the cement.

Quality of Cement from Sewage Sludge.—The quality of the cement made in this way will manifestly greatly depend upon the composition calcination, carried to the point of incipient fusion, of an intimate admixture of lime and argillaceous substances as its essential components; such calcination being followed by the grinding of the product to the fineness of flour.

I. PACKAGES AND WEIGHT.

Portland cement must, as a rule, be packed in standard sized casks, weighing 180 kilograms gross, and 170 kilograms net (397 pounds and 375 pounds), and in half sized standard casks of 90 kilograms gross and 85 kilograms net (199 and 188 pounds). The gross weight must be clearly marked on the casks.

If the cement is wanted in other sized casks or in sacks the gross weight must be plainly indicated in figures upon each packages.

Leakages, as also variations in individual packages, must not exceed 2 per cent. The casks and sacks must bear, in addition to the weights, the name of the firm or the factory trade-mark of the maker plainly indicated on each.

Facts in support of I.—Both in the interests of the purchaser, and also to ensure sound business, the adoption of a uniform weight (for packages) is urgently required. For this purpose, by far the most usual, and as respects the commercial world, the almost universal weight of 180 kilograms tare, about 400 pounds English has been selected.

II. TIME NEEDED TO SET.

In accordance with the purpose for which it is required Portland cement may be furnished to set either slow-

ly or rapidly. Such cements are to be regarded as slow setting, which take two hours and more to become set.

Explanations to II.—In order to determine the period needed to set, in the case of slow setting cements, a sample of the neat cement is stirred for three minutes with water into the form of a stiff paste, but for quick setting cements the stirring is to be for one minute only. The mixture must then be spread on a glass plate at a single operation in the form of a pat about $1\frac{1}{2}$ centimetres ($\frac{1}{2}$ inch) thick, but thinning out at the edges. The consistency of the cement paste needed for this pat is to be such that when placed upon the plate, with a spatula, a few taps upon the glass suffice to cause the mass to flow out to a thin edge; for this purpose from 27 to 30 per cent. of water will generally suffice. As soon as the pat has become hard enough to withstand a gentle pressure with the finger-nail the cement is to be regarded as having become set. In order to ascertain precisely the setting time, and to determine the beginning of the set, which (as the cement must be worked up before the set begins) is a matter of importance in the case of quick setting cements, a normal needle of 300 grams ($10\frac{1}{2}$ oz.) weight is employed which has a flat end with a superficial area of 1 square millimetre (0.015 square inch). This surface being at right angles to the axis, a metal ring of 4 centimetres in height and 8 centimetres in clear diameter ($1\frac{1}{2}$ inches and 3 inches) is placed on a glass plate, filled with cement paste, gauged as above, and placed beneath the needle. The interval of time which elapses between the gauging and that when the needle is no longer able to penetrate the entire depth of the paste, is regarded as that needed for the beginning of the set, and the time which expires until the needle will no longer produce any noteworthy impression on the hardened surface is the time required for the set. As the setting of cement is influenced by the air temperature and by that of the water used for gauging purposes, in that the higher is the temperature the more rapid is the set, and the lower the temperature the longer is the time needed for setting, it is advisable, in order to obtain uniformity in the results, to conduct the observations at a mean temperature of air and water of from 15 to 18 degs. Celsius (59 to 64.4 degs. F.)

During the set there should be no perceptible elevation of heat in the case of slow setting cements, while, on the other hand, quick setting cements may manifest a notable increase in temperature.

Portland cement becomes by long storage slower in set, and increases in tensile strength, if it be kept in dry places, free from draughts. The still widely prevailing opinion that Portland cement deteriorates in quality by long keeping is, therefore, erroneous, and contract clauses which specify the employment only of fresh cement should be abandoned.

III. FREEDOM FROM CHANGE IN VOLUME.

Portland cement must be constant in volume. The decisive test of this quality shall be that a pat of neat cement, placed on a glass plate and protected from too rapid drying, immersed in water at the end of twenty-four hours, and kept under constant observation for a longer period, shall manifest no tendency to crumble or to show signs of splitting at the edges.

Explanations to III.—In carrying out this test, the pat prepared to determine the time needed for setting should after the lapse of twenty-four hours in the case of slow setting cements, but in any case only after the pat has become set, be placed in water. In the case of quick setting cements, the pats may go into the water in an even shorter period of time. The pats of slow setting cement must, until they shall have become set, be protected from draughts

and sunshine; this may best be done by putting them into a covered box or by placing them beneath a damp cloth. By this means the formation of hair cracks, due to shrinkage in rapid drying, will be avoided; such cracks generally appear in the center of the pat, and are liable to be mistaken by unskilled observers for cracks caused by blowing.

If during the process of induration under water any crumbling takes place, or if cracks become manifest, this undoubtedly denotes the blowing of the cement; that is to say, that in consequence of its volumetric expansion the cement becomes cracked and a gradual disintegration of the first formed cohesion takes place, which may ultimately lead to the complete disruption of the mass. The indications of blowing generally become apparent in the pats after about three days, but at all events observations extending over twenty-eight days are sufficient.

[TO BE CONTINUED.]

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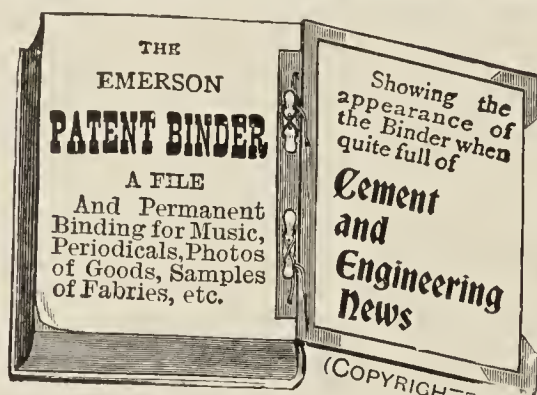
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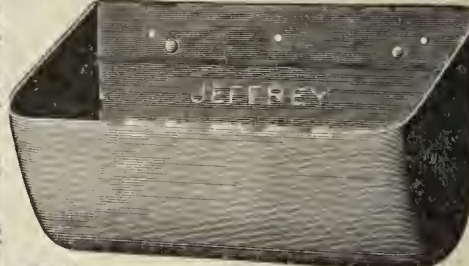
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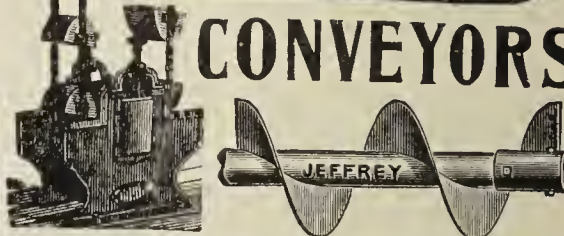


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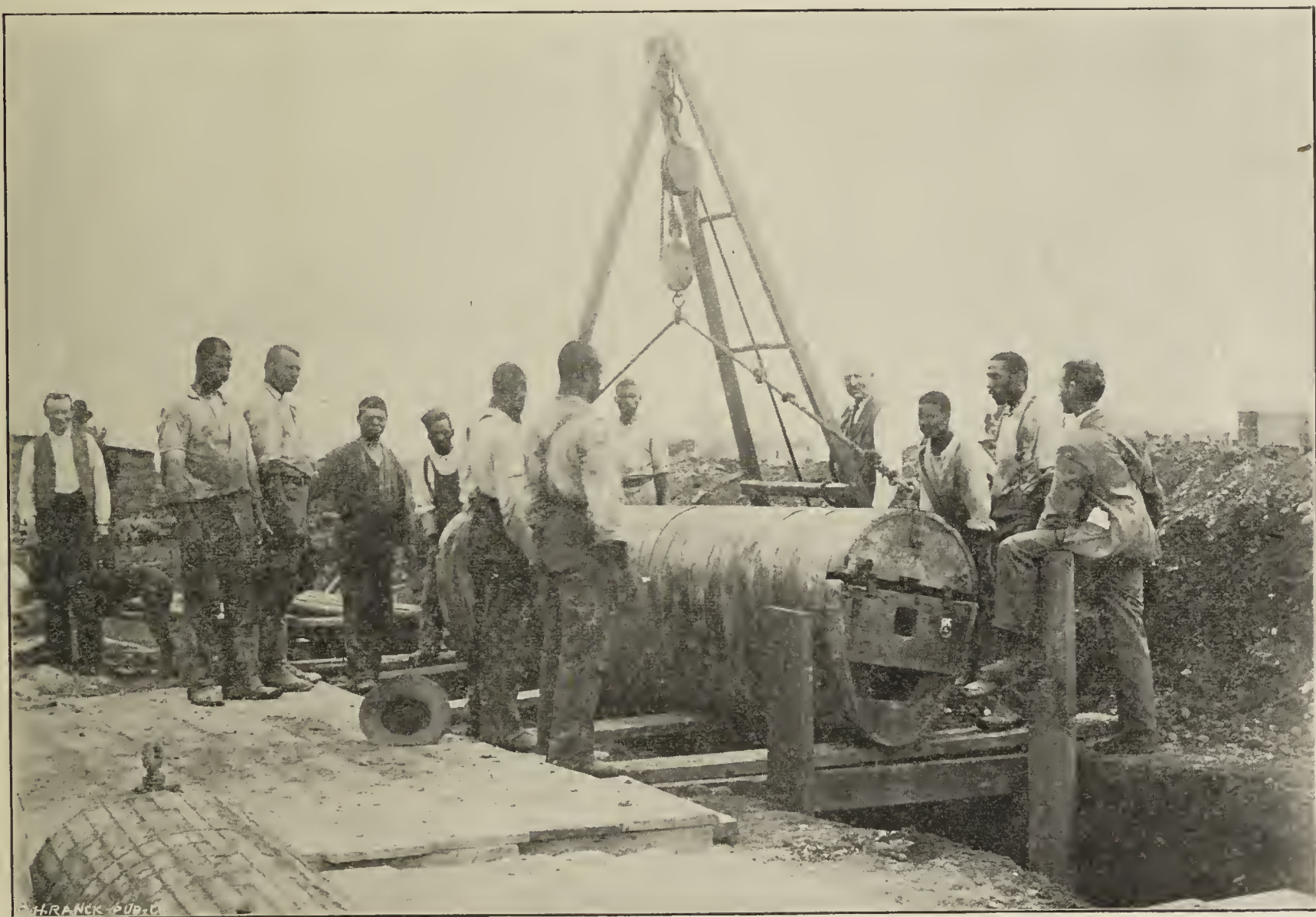
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CEMENT

.....AND.....

ENGINEERING NEWS



CONCRETE SEWER CONSTRUCTION NORTH CAROLINA AVE., WASHINGTON, D. C.

CAPT. LANSING H. BEACH, U. S. Engineer in Charge.

ALEXANDER CRAWFORD CHENOWETH, Contractor.

FIG. 1. Shows centering about to be lowered into place in the trench; the eye bolts at end that serve to hold the steel ribbon, and serve to fasten a sling rope to.

CEMENT FROM SEWAGE SLUDGE.

(Continued from page 61.)

IV. FINENESS OF GRINDING.

Portland cement is to be so finely ground that the residue from a sample of the same passed through a sieve of 900 meshes per square centimetre (5,806 per square inch or 76 per lineal inch) shall not exceed 10 per cent. The diameter of the sieve wire should be equal to half the clear opening of the mesh.

Explanations to IV.—In the case of each sieve test 100 grams (0.22 pounds) of cement are to be used.

As cement is in nearly every instance employed with sand, and in some cases with a large proportion of sand, while the cohesive strength of a sample of mortar is greater just in proportion as the cement is finely ground (because under these circumstances more particles of the cement come into action), the fineness of the grinding is of the utmost importance. It appears, therefore, to be evident that the fineness of the particles should be uniformly checked by the use of a fine sieve of the above number of meshes to the inch. It would, however, be misleading if the quality of a cement were to be determined alone by the fineness of the grinding, for inferior tender burned cements are much oftener found to be well ground than good hard burnt cements. The latter will, however, even if coarsely ground, possess a greater cohesive strength than the former. If the cement is to be used mixed with lime, it will be expedient to employ hard burnt cements, extremely well ground, the relatively high cost of which will be compensated for by the manifest improvement of the mortar.

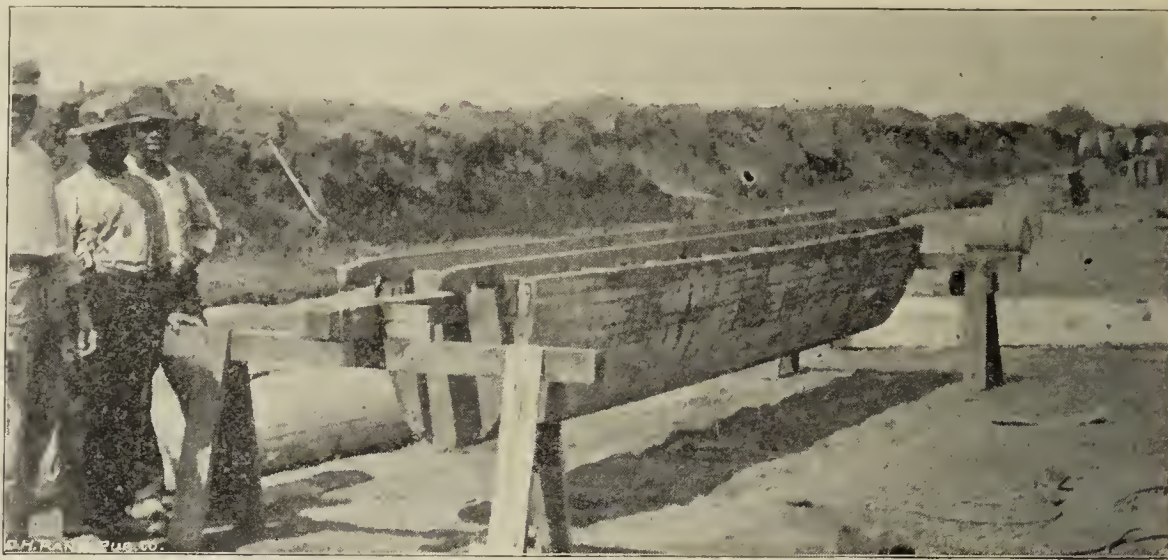
V. TEST TO ASCERTAIN THE STRENGTH OF THE CEMENT.

The cohesive strength of Portland cement must be ascertained by testing a mixture of cement and sand. The testing should take place upon a uniform system both in tension and compression, and should be carried out with test samples of the same shape and sectional area, and with similar apparatus.

Together with these tests it is expedient also to ascertain the cohesive strength of the neat cement.

The tensile tests are to be carried out with briquettes, having a sectional area at the point of fracture of 5 square centimetres (0.775 square inches).

Facts in support of V.—As it is impossible uniformly to pronounce an opinion upon the cohesive strength of a sample of cement when employed with sand by means of experiments conducted with that cement without



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FIG. 2. Another view of the centering.

sand, particularly when it becomes necessary to compare the cements of different makers, it is, therefore, imperative to test the cement along with sand.

The testing of neat cement is to be advocated when it is required to prove the value of Portland cement as compared with mixed cements and other hydraulic binding materials, because on account of its high tensile strength when used neat, in which respect it surpasses all other similar materials, it shows to greater advantage tested thus than when tested with sand.

Although the proportional strength under compression and under tension differs in the case of various binding agents, it is, nevertheless, customary to employ the tensile strength as indicative of the value of the different hydraulic cements. This, however, leads to an unfair valuation of their properties. And further, whereas in all practical applications of mortar the resistance to compression is the first consideration, it is only these latter tests which can be relied upon to furnish really conclusive results.

To secure the necessary uniformity in the tests it is advisable to make use of the same description of testing apparatus and tools as those employed in the Royal Testing Station at Charlottenburg, Berlin.

VI. TESTS UNDER TENSION AND COMPRESSION.

Slow setting Portland cement shall, when tested with 3 parts by weight of standard sand, after a period of twenty-eight days induration—one day in air and twenty-seven days in water—attain a minimum tensile strength of 16 kilogramms per square centimetre (227 pounds per square inch). The strength under compression shall be at least 160 kilogramms per square centimetre (2,275 pounds per square inch). In the case of

quick setting cements the tensile strength after twenty-eight days is generally inferior to the above. It is, therefore, necessary, when stipulating the amount of the tensile strength, to indicate also the time needed for the set.

Explanations.—As different cements may vary very considerably as respects their power to unite sand, upon which property their industrial application mainly depends, it is imperatively necessary, in the comparison of several samples of cements, to test them with a large proportion of sand. It is assumed that the most suitable proportion for this purpose is 3 parts by weight of sand to 1 part of cement. Since it is with 3 parts of sand that the binding power of the cement comes adequately into play.

Cement which exhibits a greater relative tensile strength as compared with the crushing strain often manifests a superior capacity for uniting sand, and merits for this reason, as likewise for its greater strength with an equal amount of sand, to command an increased selling price.

The standard test under compression is that after twenty-eight days since it is not possible when comparing several kinds of cements to properly ascertain the binding capacity in a shorter period of time. Thus, for instance, after twenty-eight days the tests of different samples of cements in comparison may be alike, whereas, after seven days only, there were important differences. The tensile strength at twenty-eight days constitutes the decisive test on delivery of the cement. If, however, a check-test at seven days is needed, this may be secured by a preliminary test when the ratio of tensile strength after seven days to that at twenty-eight days in the case of any given sample of cement has been determined. This preliminary test may also be carried out with neat cement,



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FIG. 3. Gives a view of collapsing rod; how arranged.

when the proportionate strength of the neat cement to that with 3 parts of cement at twenty-eight days has been ascertained.

It is advisable in all cases, where there is a possibility of so doing, to extend the tensile tests over a longer period, by means of cement samples prepared beforehand for this purpose, in order to learn the behavior of various cements during a longer period of induration.

To attain uniformity in the results it is in all cases necessary to employ sand having grains of the same size and of the same quality. This normal sand is prepared as follows: The purest possible quartz sand is washed, dried, and passed through a sieve of 387 meshes per square inch to eliminate the coarser particles, and then through one of 774 meshes per sq. inch to remove the finer particles. The thickness of the wires not to exceed 0.015 inch and 0.012 inch respectively.

As all samples of quartz sand when treated in the same way do not manifest the same cohesive strength, it is necessary to ascertain whether the specimen of normal sand employed gives uniform tensile tests with those shown in the case of the sand supplied for testing purposes under the authority of the German Cement Manufacturers' Association, which sand is also used at the Royal Testing Station at Charlottenburg, Berlin.

Description of the Tests Employed to Ascertain the Tensile and Cohesive Strength.—As it is important to secure absolute uniformity in the results in testing the same cement in different places, it is imperatively necessary to adhere most strictly to the rules that are here indicated. In order to obtain correct averages at least ten test pieces must be prepared for each set of experiments.

PREPARATION OF THE CEMENT WITH SAND TEST-PIECES.

Tensile Tests.—The tensile test-pieces may be prepared either by hand or by mechanical means.

(a) **By Hand Work.**—On the sheet of metal, or thick glass, serving for the formation of the test-pieces, must be placed five pieces of blotting-paper saturated with water, and on these are laid the five molds, also rinsed out with water. Then 250 grams (8.8 ozs.) of cement and 750 grams (26.4 ozs.) of dry normal sand are weighed out and well mixed together in a basin. To this mixture must now be added 100 c.c. = 100 grams (3.52 ozs.) of pure fresh water and the whole mass is then briskly stirred for five minutes. The five molds are then filled with the mortar thus prepared, which is pressed into them and well heaped up into a curved form above the top. By means of an iron spatula, having a surface of $2\frac{7}{8} \times 1\frac{3}{8}$ inches, 13 inches in length and weighing $7\frac{1}{4}$ ozs., the mortar is tapped softly near the edges to begin with, and then gradually harder, so as to drive it down into the mold, until the whole mass becomes elastic, and water appears on the surface. It is absolutely necessary to continue the process of the filling-in of the molds until this stage is reached, which will need about one minute per mold. It will not do to introduce a second supply of mortar and to beat that down, because it is essential to keep the test-pieces made with the same kind of cement at different testing stations identical in point of density. The superfluous cement is then struck off with a knife, and the surface is polished over with the same. Then the mold is carefully removed, and the test-pieces are placed in a box, lined with zinc and provided with a cover, in order to avoid un-

equal dessication, caused by variations in the temperature. Twenty-four hours after they are made the test-pieces must be placed in water, and care must be taken to keep them covered with water during the whole period of induration.

(b) **Preparation by Mechanical Means.**—After the mold, with the filling box attached to it, has been securely fastened to the bottom plate by means the two thumb-screws, 180 grams of the mortar, prepared as in the foregoing instructions (a) are introduced into the mold for each test, and the iron molding core is placed in position. Then, by means of Dr. Bohme's percussion apparatus having a hammer weighing 4.4 lbs., 150 blows are imparted to the core.

After the removal of the filling-box and the core, the test-piece is struck off level and polished as before; then taken off in the mold from the bottom plate and dealt with as in the case of (a) above.

By careful attention to the foregoing rules, hand-made test-pieces and those prepared mechanically give fairly uniform results. In disputed cases, however, tests made by mechanical means must be regarded as decisive.

Tests under Compression.—In order to secure uniformity in the results of testing by compression carried out at various testing stations, it is necessary to have recourse to mechanical preparation of the tests.

Fourteen ounces of cement are weighed out and well mixed in a basin with 42 ozs. of dry normal sand. 160 c.c. = 5.63 ozs. water are then added, and the compound is briskly stirred into mortar for five minutes. Then 30 ozs. of this mortar are inserted into the cubical mold, having the filling-box attached, the whole being securely fastened by screws to the bottom plate. The iron core is placed in the mold, and is caused to receive 150 blows from Dr. Bohme's percussion apparatus with a hammer weighing 4.4 lbs. After the removal of the filling-box and the core, the test-block is struck off and polished, taken off the bottom plate in the mold and dealt with as in the case of (a) above.

Preparation of Test-Pieces of Neat Cement.—The molds are slightly oiled on the inner surface and placed on the metal or glass plate (without any blotting-paper under them.) Then 35.2 ozs. of cement are weighed out, and to this is added 7 ozs. = 200 c.c. of water, and the whole are well stirred for five minutes (this is best done with a pestle) filled into the molds so as to be well heaped up above the surface, and then dealt with as in (a). The molds can, however, only be removed when the cement is sufficiently set.

As, during the ramming in of the neat cement, the aim is to produce test-pieces of the same consistency, the added water must be proportionately increased in the case of very finely ground or quick-setting cements. The amount of water employed must always be indicated when stating the figures representing the tensile strength.

Method of Carrying Out the Tests.—All test-pieces must be tested immediately after they are taken out of the water. As the time the load is being applied has an influence upon the result, the weight should, in the case of tensile tests, be increased at the rate of 3.52 ozs. per second. The mean of ten tests is to be taken as the ascertained tensile strength.

THE END.

THE NORTH CAROLINA AVENUE CONCRETE SEWER, WASHINGTON, D. C.

The following is from the October issue of *Stone* to whom we are indebted for the illustrations:

The sewer was built by the Commissioners, Capt. Lansing H. Beach, U. S. A. Engineers in charge; Alexander Crawford Chenoweth, Contractor.

The size of sewer was 3 ft. 7 ins. x 2 ft. 2 ins. egg shape, 9 ins. thick, with a terra cotta invert block in bottom, and two rows of vitrified brick. Length of sewer 799 feet. The concrete from which the sewer was built consisted of the following proportions: 1 barrel of American cement, 2 barrels of sand, 4 barrels of gravel. The 799 lineal feet of sewer consumed the following quantities of material:

49 cubic yards of cement at \$7.69 per yard.....	\$ 376.90
154.6 cubic yards gravel at \$1.15 per yard	177.79
79.8 cubic yards sand at \$1.00 per cubic yard.....	79.81

When mixed 283.4 cubic yards material in concrete, total cost..... \$ 634.50

Labor employed was paid \$1.25 per day of 8 hours. Eight men were mixers and handlers of cement, four men were employed in winding and handling the centering. Total cost of labor \$687.14, one-third of which was for handling the centering, and two-thirds for mixing and handling cement 687.14

Total cost of concrete in place, or actual cost of main sewer exclusive of excavation of trench and timber bracing.. \$1,321.64

Total cost of concrete in place 284 cubic yards \$1,331.65 or \$4.68 per cubic yard or \$1.65 per foot of sewer built.

The following items of cost enter into the construction of this sewer, which are additional and incidental.

Brought forward.....	\$1,321.64
Two rows of vitrified brick, 6,292 brick \$15.50 per M.....	124.64
799 feet of invert terra cotta brick	341.40
For excavating and backfilling timber bracing, 799 feet of trench of 16 feet deep, material hard conglomerated clay, but liable to flake, of regular bracing, 2,255 cubic yards at 70 cents.....	1,587.13
The specification called for a covering of the outside arch of sewer to the spring line with a coating three-eighths inch thick of Portland cement, mixed with sand, proportion 1 to 1. Also inside of sewer to spring line. This required Forty-five barrels	
Portland cement.	\$116.10
Thirty cubic yards sand.....	31.50

Including labor.... 147.60

Total cost of sewer \$4.41 per foot of sewer built..... \$3,522.41

The sewer was built by means of the Chenoweth centering, which consists of a collapsing wooden centering wound with a spiral band of cold rolled steel 6 inches wide and one twenty-second of 1 inch thick. This band is fastened to wooden centering at the ends to prevent unwinding. The centering is then given a coat of oil. The coat of oil serves a purpose to be explained hereafter. The centering as above described is now ready to put in place. The bottom of sewer being brought to grade, and concrete laid so that the terra cotta invert blocks when placed are at grade, the center-

ing being placed thereon was packed about with concrete lowered in buckets. The work progressed until the centering was completely covered. At this stage the wooden mandrel is collapsed and removed, leaving the steel band to perform the function of sustaining the concrete until hard when the band can be drawn out and used over.

The operation is repeated over as many times as desired.

In constructing this sewer the centerings were sixteen feet long and quite heavy, but readily pushed to the derrick as shown in photograph, when all the moving and placing was done by derrick. It was found the surface of steel band, when oiled, made a perfectly smooth surface for inside of sewer, and by giving the centering a coating of soft mixture of concrete and sand a remarkably smooth interior was the result. The time required to lay a sewer by this method was very short, as eighty to ninety feet of sewer per day was easily accomplished. The excavation and bracing proved slow and tedious by reason of the material. Very rapid work can be done in the way of building concrete sewers by this method, as well as economical. A saving in concrete could be made by not building the sewer nine inches thick, five inch would answer as well.

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FIG. 4. Shows a piece of sewer built and the centering in place ready for concrete.

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(PUBLISHED MONTHLY)

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OUTPUT OF AMERICAN PORTLAND CEMENT.

The output of the American Portland cement mills for 1898 will exceed 3,000,000 bbls. This is not the full producing capacity of the mills and only represents the output of about nine months' run.

The mills working on marl shut down four months or more each year, while those working on rock can run fully eleven months if desirable. They have not done so, as a rule in the past, either from a lack of storage capacity for the manufactured product, or the unwillingness to lock up the capital required to carry the winter's product over to the opening of the next season, preferring to invest their ready cash in enlarging their capacity and for the general betterment of the works.

Therefore, with the raw materials stored and available for a full eleven months' run on part of the mills working on marl, the present producing capacity of the American Portland cement mills could easily be brought up close to 4,000,000 barrels, annually, instead of the present output of a slight excess of 3,000,000, actually produced.

The policy of many of the larger mills now is to increase their storage capacity many fold to take care of their winter's run, while the large

trunk lines are offering free storage, to producers at manufacturing points and large distributing centers for cement, in their freight houses for the resulting increase of freight this policy insures. This will place the mills in a better position to meet the strong demand for their product which the opening of next year's trade will present.

The mills during the past season have had everything in their own favor, in the face of a demand for their product, estimated at from 450,000 to nearly 1,000,000 barrels in excess of the year's output. The American mills are to be congratulated on the excellence of their product and its appreciation by the domestic consumer. One of the finest compliments paid to the American Portland cements in strictly commercial channels is the ruling quotations and sales in Atlantic seaboard cities at ten cents higher than the imported brands.

With the increased capacity, now well under way, of the older mills together with the numerous new mills coming into the market with their product in the early spring, will bring the output of the country up to about 5,000,000 barrels for 1899. Considering the various new plants only recently coming under our notice together with the vast scale of enlargement of the existing mills, the combined output must be fully able

to meet the legitimate demand by the close of the season of 1899, at which time there may be a slight shading of prices.

The American mills are and have heretofore been handicapped in bearing the entire cost of production and carry their customers from sixty to ninety days. It is otherwise in Europe, where the mills usually grind on orders and receive payment for their product when ready for delivery, their customers receiving, storing and carrying their own orders and thus relieving the mills of a great burden. This enables them to make lower mill prices. It will be some time before this practice can be adopted in the United States. When it does come the small dealers will be compelled to rely on dealers having direct mill contracts.

CONCRETE AND EXPANDED METAL FACTORY BUILDINGS.

The Central Expanded Metal Co. of Pittsburg, Pa., have, during the past two years, constructed of expanded metal, steel structural frame and Portland cement concrete, four large factory buildings from 100 to 350 feet long, and one office building 70 by 30, for the W. & H. Walker Soap Works, located on Herr's Island in the Allegheny River, Pittsburg. The floors, outside and inside, walls and roof are all concrete with expanded metal embedded therein and is in every respect a model system of concrete construction for a fire-proof factory plant, the steel structural frame being entirely covered and protected by concrete.

IMPORTS OF CEMENT INTO THE UNITED STATES.

WHERE FROM.	SEPTEMBER.				NINE MONTHS ENDING SEPTEMBER.			
	1897.		1898.		1897.		1898.	
	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.
United Kingdom....	14,986,186	50,735	10,802,414	38,921	93,586,943	304,434	58,902,741	203,022
Belgium.....	12,603,059	36,113	35,284,479	109,733	145,844,813	424,482	205,777,724	612,895
France.....	7,892,405	21,859	297,000	1,197	13,576,278	39,722	2,664,800	10,094
Germany.....	45,860,637	161,174	35,635,373	124,433	352,935,523	1,161,683	300,293,619	1,016,472
All Other Europe...	1,388,900	4,484	1,892,014	6,306	13,398,900	48,553	17,004,732	53,246
British North Am...	389,824	1,888	185,400	879	1,345,399	6,388	1,367,950	6,560
Other Countries.....	.....	.....	.....	.....	411	1	5,200	67
TOTAL.....	83,121,011	276,253	84,096,680	281,463	620,688,267	1,985,263	586,016,766	1,902,356
Domestic Exports of Cements, bbls.	4,267	7,192	4,125	7,782	40,809	72,167	26,550	52,006

There were 3,382,384 lbs. of imported Roman and Portland cements, etc., in the United States bonded warehouses on September 30, 1898, valued at \$10,386 against 11,522,847 lbs., valued at \$38,100, in September, 1897. Imports of asphaltum or bitumen for September, 1897, were 5,752 tons valued at \$27,260; September, 1898—15,864 tons valued at \$15,267. For nine months ending, September 1897, 103,442 tons valued at \$355,990; for nine months ending September, 1898—59,137 tons valued at \$148,481.

HISTORY OF THE PORTLAND CEMENT INDUSTRY IN THE UNITED STATES.

By MR. ROBERT W. LESLEY,
Associate Am. Soc. C. E.

From *The Journal of the Franklin Institute*.

To the general public, cement is usually associated with the numerous works of the Romans, but, in point of fact, the mortars used in the Roman construction were not of cement at all, but were mixtures of slaked lime and pozzolana, a volcanic dust which was found in large quantities in Italy. It was not until the end of the last century that the true principles of hydraulic cement were discovered by Smeaton, who, in the construction of the Eddystone Light-House, made a number of experiments with the English limestones and laid down, as a result, the principle that a limestone yielding from 15 to 25 per cent of residue when dissolved in hydrochloric acid will set under water. These limestones he denominated hydraulic limestones and from the principle so laid down by him come the two great definitions of what we now know as cement, namely, the artificial cements of commerce.

The first class of cement, the natural, such as the Rosendale, Lehigh and Cumberland cements, was first made by Joseph Parker in 1796, who discovered what he called "Roman cement," based upon the calcination at low temperatures of the nodules found in the septaria geological formation in England. This was practically the first cement of commerce, and gave excellent results. Subsequent to the discoveries by Smeaton, General Sir William Paisley went into an exhaustive series of chemical and other tests to determine how artificial cements could be produced which would correspond to the higher grades of hydraulic limestones described by Smeaton and the Roman cement which was then commanding the market. Contemporaneous with him and working in the same scientific field was Vicat, a French engineer, who conducted investigations of the same general character, and, in his book on hydraulic limestones and cements, describes his many experiments which led to the scientific development of a Portland cement artificially made by calcining mixtures of chalk and clays at high temperatures to incipient vitrefaction.

While these experiments were going on, Joseph Aspdin, a brick-layer or plasterer, took out a patent in England in 1824 on a high grade artificial cement, and, at great personal deprivation, succeeded in manufacturing it on a commercial scale



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FIG 6. Shows a centering wound, the winding arrangement, center winding rod and end rests. The rods projecting at end are the collapsing rods, and serve to tighten the ribbon on the centering; by driving these rods in, say two inches, they will drive apart the centering which tightens up the steel band. To continue driving it would collapse the centering, this being done when the centering is in the ditch and covered with concrete.

by combining English chalks with clay from the river beds, drying the mixed paste, and after calcining at high heat the material thus produced, grinding it to powder. This cement, which was the first Portland cement in the market, obtained its name from its resemblance when it became stone to the celebrated Portland stone, one of the leading building materials in England.

The growth of the natural or Roman cement industry in England was more rapid than that of the Portland cement and in the early days of Portland cement that article was sold at prices considerably lower than those of the Roman cement manufactured by Parker and his successors in the business. It was not until many years after Smeaton's discovery that there was much growth in the Portland cement industry. A few works were started in England and a few more were started on the continent by friends or relatives of Aspdin, but the demand was very slight, and there was a doubt in the minds of engineers as to the character of the material. Along in 1850 when the question of building the London drainage works came up, John Grant, the engineer, decided to use Portland cement in its construction, and his two papers, published by the Institute of Civil Engineers, form the first scientific literature on the subject of cement testing, and were the first to put Portland cement to the front as a material upon which engineers could rely to the fullest extent.

In this country we make the natural cements similar to the Roman cement of Parker, and also the Portland cement of Aspdin. The laminated cement rock of the Lehigh

region from which, among others, natural cement is made, is calcined in open kilns, like lime kilns, a moderate heat only being used. The product is then ground, put into barrels and is ready for shipment.

The rocks used in the manufacture of Portland cement are very similar to those from which natural cement is made. The various layers in the natural rock may vary in size or stratification, so that the lime, alumina and silica may not be in position to combine under heat, or there may be too much of one ingredient, or not enough of the others in close proximity to each other. In making Portland cement these rocks, properly proportioned, are accordingly ground to an impalpable powder, the natural rock being broken down and the laminae distributed in many small grains. This powder is then mixed with water, and is made into a new stone in the shape of the brick or block, in which all the small grains formerly composing the laminae of the original rock, are distributed and brought into a close mechanical juxtaposition to each other. The new rock thus made is put into kilns with layers of coke, and is then calcined at temperatures from 1,600 deg. to 1,800 deg. The clinker, as it comes from the kiln, is then crushed and ground to an impalpable powder, which is the cement of commerce. Portland cement may be made from other materials, such as chalk and clay, limestone and clay, cement rock and limestone and marls and clays. In every case the principle is the same, the breaking down and redistributing of the materials so that the fine particles may be in close mechanical union when subjected to the heat of the kiln.

The first branch of the industry to develop in this country was that of natural cement, and its inception was largely because "necessity is the mother of invention." The first large public works built in this country were the canals, and the most necessary thing to build a canal was mortar that would hold the stones together at the locks, or walls, under water. Consequently, wherever canals were to be built, there was a search for cement rocks, and all the earliest works in this country were established on the lines of canals. Thus, on the Chesapeake and Ohio Canal are the Cumberland and Round Top Works; on the Lehigh Canal the works at Siegfrieds and Coplay, Pa.; on the Richmond and Allegheny Canal, the works at Balcony Falls, Va.; on the Delaware and Hudson Canal the large group of works at Rosendale and Kingston; and on the Falls of the Ohio Canal, the large aggregation of works about Louisville. From this same fact grew the early package used in shipping cement in this country, the barrel, which was the package best adapted to water transportation, and it took many years, even since the railroads came, to overcome the prejudice for this form of package and to substitute the paper or duck bag for the barrel.

The growth of the natural cement industry has been very rapid, having increased from 3,000,000 barrels in 1882 to about 8,500,000 barrels in 1896. The first Portland cement made here involved a great cost of labor, and could not be offered at prices very much below the foreign article, and, as the Portland cement in a building costing \$1,000,00 to \$1,500,000 represented only a small percentage of the total cost, and as the difference between the American and the foreign article represented only a small percentage of this amount, it was almost impossible to convince engineers and architects that American Portland cement should be used. It is an interesting fact that among the first great works to use American Portland cement were the jetties built by Capt. Jas. B. Eads, and among the first buildings in which American Portland cement was used was the Drexel Building, Philadelphia. By slow degrees, however, the prejudice in favor of the imported Portland was overcome and the American industry showed its right to exist.

The first American Portland cement plant was that of the Coplay Cement Company, of which Mr. David O. Saylor, of Allentown, was the president. This plant was established about 1865 and made natural cement of excellent quality. Mr.

Saylor, who was a man of indomitable energy and great ability, made up his mind in the early seventies that he could make Portland cement in this country, and his first experiments are most interesting. He knew that by burning to incipient vitrification the rocks of his quarry he could make a cement that at short periods showed tensile strains equal to the imported Portland, but he found this cement would crumble away as time went on, owing to the variation in the raw material. By sheer force of his native ability, Mr. Saylor studied out and successfully applied to the Lehigh rocks the principle above mentioned as governing the production of Portland cement, though he was dealing with a material never before used for the purpose. The process was that which I have just described, and is still in use in some of the largest works in the Lehigh district. Mr. Saylor's work was materially aided by Mr. John W. Eckert, a graduate of the Lehigh University, who became first the chemist and afterwards the superintendent of the Coplay Cement Company, Mr. Saylor's concern at Coplay Station, which he subsequently left to join in the establishment of the American Cement Company.

While this experiment was being carried on to success in the Lehigh region, and the foundations were being laid for the large industry that now exists, a small works was erected near Kalamazoo, Mich., in 1872. Owing to the character of the material and the high cost of labor and fuel, this works made cement which was too expensive commercially and did not succeed. Early in 1875 works were started by Mr. Shinn at Wampun, Pa., near Pittsburg, using limestone and clay. These works are still going, though they have not been very materially increased since their inception. At South Bend, Ind., Thos. Millen, an Englishman, found a white marl and blue clay which resemble in composition, though not quite in form, the materials used for cement making in England. He started a small works there in 1877, and the plant is still running, though in a moderate way. Mr. Millen later transferred his field of operations to New York State. The Rockland, Me., lime is well known as one of the best and purest in the country, and it was but natural that the Portland cement industry should seek a lodgment in that field. The Cobb Lime Company, an important concern there, started works in 1879, but the product was too dear for commercial success, and they were closed down. For similar causes a similar fate overtook the National Cement Company, which was established by Mr.

S. D. Coykendall and others on the Hudson, in the well-known natural Rosendale district. Thus it may be seen that out of the six original works started in this country prior to 1881, three were failures, and certainly the industry, with this percentage of loss, did not offer very encouraging outlook to the investor. At this period, the foreign Portland had the market exclusively and there seemed little likelihood of growth for the American industry.

Patents were necessary to enlist capital in the earlier enterprises, and many of the earlier works were founded on them. The great difficulty in all the American enterprises seemed to be the cost of getting the raw material into powder, then into paste, then into bricks or blocks and then into the kiln with a sufficient economy. About 1884 and 1885 patents were taken out by Messrs. Jas. M. Wilcox, E. J. Smedt and Robert W. Lesley for the purpose of mixing liquid hydrocarbons with the paste. In this way a "slurry" was made, which, when compressed into balls or eggs, could be at once put into the kilns and thus many of the intermediate steps of drying, etc., were dispensed with, and much labor and money saved. These processes, which were used in the works started by the American Cement Company at Egypt, Lehigh county, Pa., under the management of John W. Eckert and Robert W. Lesley, were based upon the use of the by-products of the manufacture of coal gas, but with the introduction of water gas and the consequent advance in the price of coal tar the processes were abandoned and other methods adopted. But the enterprise proved successful, and the company now controls five large works, four at Egypt, Lehigh county, Pa., and one near Syracuse, N. Y., and is one of the largest producers of Portland cement in the country. While these methods of saving the intermediate processes of drying were being used, other inventions by Mathey, Navarro and Ransome in the same direction gave rise to the establishment of the Atlas Portland Cement Company, which has two large works in the Lehigh region and is another great producer of cement. These processes, based originally on the calcination of the crushed raw rock by oil in revolving kilns, were at first unsuccessful, the cement proving unreliable for the same reason that gave Saylor so much trouble originally. Subsequently, however, improvements were made whereby the material was ground to an impalpable powder and slightly moistened before being run through the kiln, and cement made in this way has proved successful, and is

made in large quantities in this country.

The above gives a brief account of the development in this country from its inception to its present period of successful manufacture and, as shown, the industry owes much to the application of American methods and American processes to a European industry. This leads to the discussion of the methods in use in this country and in Europe.

[TO BE CONTINUED.]

Cement and Engineering News \$2 per annum.

The Alpha Portland Cement Co. is increasing its plant up to a capacity of 2,000 bbls. per day for next season's run.

The Glens Falls Portland Cement Co. have commenced the erection of two new kilns and will build a large fire-proof storehouse for cement storage. It will consist of a number of large bins built of fire-proof brick and properly enclosed, conveyors from the mill to the bins and from the bins to the packing rooms will handle the cement to and from the storehouse.

DIVIDENDS AND STOCK VALUES OF GERMAN PORTLAND CEMENT WORKS.

Adler Portland cement fabrik, ordinary stock, no dividends; value 45.75. Preferred stock, 1896, 8½ per cent; 1897, 10 per cent; value 153.60.

Alsensche Portland cement fabrik, 1896, 16 per cent; 1897, 18 per cent; stock value 274.00.

Giesel Portland cement fabrik, 1896, 9 per cent; 1897, 10 per cent; stock value 167.50.

Hemmoor Portland cement fabrik, 1896, 6½ per cent; 1897, 11 per cent; stock value 190.80.

Oppelner Portland cement fabrik, 1896, 10 per cent; 1897, 11 per cent; stock value 178.25.

Schimischo Portland cement fabrik, 1896, 8 per cent; 1897, 8 per cent, stock value, 136.75.

Schlesische cement fabrik, 1896, 13½ per cent; 1897, 14½ per cent; stock value, 233.50.

Stettin-Bred. Portland cement fabrik, 1896, 7 per cent; 1897, 9 per cent; stock value 192.50.

Cementwerk, Heidelberg, 1896, 8 per cent; 1897, 8 per cent; stock value 167.50.

Cementfabrik, Karlstadt, 1896, 8 per cent; 1897, 8 per cent; stock value 130.50.

Bremer Portland cement fabrik, 1896, no dividend; 1897, 4½ per cent; stock value 90.00.

Ob-Schles. cement fabrik, 1896, 9 per cent; 1897, 11 per cent; stock value 176.00.

Groschowitz Portland cement fabrik, 1896, 13½ per cent; 1897, 14½ per cent; stock value 233.00.

Portland cement fabrik, Gossnitz, 1896, 8½ per cent; 1897, 9 per cent; stock value 170.00.

Hanover Portland cement fabrik, 1896, 13 per cent; 1897, 20 per cent; stock value 284.00.

Hoxtersche Portland cement fabrik, 1896, 2 per cent; 1897, 10 per cent; stock value 168.00.

Lunb. Portland cement fabrik, vorm. Heyn Gebr., 1896, 10½ per cent; 1897, 13 per cent; stock value 205.00.

Vorwohler, Portland cement fabrik, 1896, 15 per cent; 1897, 18 per cent; stock value 226.00.

Braunsch. Portland cement works (Salder), stock value 100.00.



CONCRETE SEWER CONSTRUCTION NORTH CAROLINA AVE., WASHINGTON, D. C.

CAPT. LANSING H. BEACH, U. S. Engineer in Charge.

ALEXANDER CRAWFORD CHENOWETH, Contractor.

FIG. 5. Shows the wooden centering withdrawn with steel bands holding the cement in place, ready for another centering. The wooden lagging projecting on ends was to procure space for plastering the inside of sewer from brick line invert to spring line. This was done more in the nature of an experiment as it was found the plastering could have been put on without any reduction in size of sewer.

The Atlas Cement Co. of Northampton, Pa., is steadily increasing its output by enlargement under the vast and well matured design to bring it up to a capacity of 10,000 bbls. per day. It is today one of the largest producers of Portland cement in the world, and is sustained by almost unlimited capital.

CHALLENGE CONVEYOR.

A new conveyor, operated by a rocking movement of the trough or conveying receptacles is being introduced by the Simpson Machinery Co. The cut shows the challenge conveyor with an ordinary semi-circular trough, which may be any length. The trough is hung on pivots or rocking hangers at certain intervals and motion is imparted to it by means of an eccentric running at a certain speed. The result is a movement of the material in the trough; a conveyor of the medium size will carry the material along as fast as three or four men can shovel into it.

One of its virtues is that it cannot

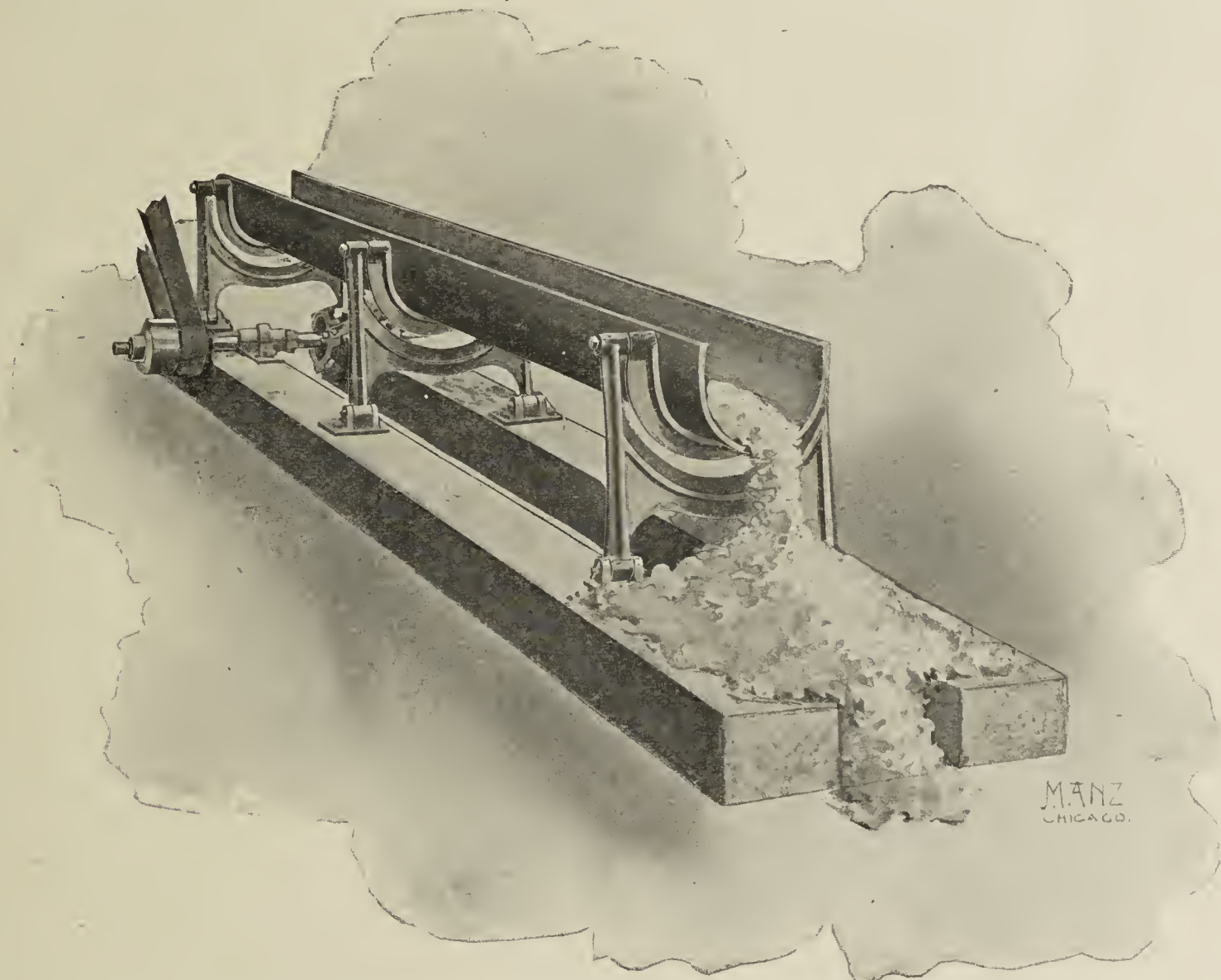
The simplicity of its construction and operation reduce the possibility of getting out of order to almost an absolute minimum. For further information, circulars and prices address Simpson Machinery Co., 77th and Jackson avenue, Grand Crossing, Chicago, Ill.

IMPORTANCE OF THOROUGH OXIDATION OF PORTLAND CEMENT.

It is well recognized that in both organic and inorganic chemical action, the products of the forces acting differ primarily according to the supremacy of one or the other of two influences, oxidation and reduction.

dusting, the effects of over-burning and under-burning, the fineness of grinding of raw material and finished product, the effect of adulterants of many kinds and percentages, the time of setting, the action under various tests and the allowable amount of magnesia, and numbers of other much discussed questions; but where have we seen it taken into consideration what effect in all these matters may be due to oxidation or to reducing action during that essential portion of the process, that crisis of the whole procedure, the clinkering of the cement?

No Portland cement of sound composition and high quality can be ob-



be clogged or choked up. The more material there is in the trough the faster it will convey.

The rocking or reciprocal movement of the trough must partake of a certain peculiar and well defined motion to urge the material forward, otherwise the material will simply stand still in the trough.

The peculiar rocking motion imparted to this conveyor will not only carry material along a horizontal plane, but up a certain well defined incline. By changing the nature of the rocking movement, the material may be made to move in the opposite direction.

Arrangements are made on the device to counteract the jar that ordinarily accompanies rapid reciprocation.

In the manufactories where metallurgical operations are carried on, the importance of the degree in which it is necessary to employ the one or the other of these influences, is well understood.

While I presume that cement manufacturers and cement chemists generally appreciate the important bearing which these influences have in burning cement, I fail in the course of considerable reading to see any discussion of this phase of the question, and have seen no adequate test defined or described for measuring the degree of oxidation existing in finished Portland cement.

We have seen great stress laid on the proportioning of the cement mixture, the thoroughness of drying, the duration of seasoning, the causes of

tained or preserved in the presence of reducing chemical action. Strong oxidizing action is as essential to its production as is life force to the production of wood fiber. All things, therefore, which would cause reducing action directly or indirectly, locally or generally, must be eliminated in the manufacture of Portland cement. Before proper clinkering can proceed, organic matter must be removed from the raw material. Sulphides must be dissociated and their components thoroughly oxidized. Free circulation and an ample supply of air must be had in the kiln. All fuel must be consumed and the presence of free carbonic oxide avoided before the completion of the clinkering.

Otherwise, however perfect may be

all the other steps of the process, or however nearly correct the composition may be, defective or even worthless cement may result.

An under-limed cement of any degree of sintering may be made to blow by the effect of reducing action in the kiln, and to give every indication of over-liming, while a sufficient supply of air and through oxidation of the same material would result in a faultless product.

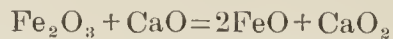
Several years of experience with various materials and various processes have convinced me that there is more significance to the cement industry, comprised in the action of complete oxidation than in any other feature of its manufacture at the present time. The quality of cement, the cheapness of its production, the diversity of its uses, the rapid determination of its soundness will all be enhanced by a fuller understanding of this part of the process of manufacture.

The writer's own ideas, though unconfirmed by any extended investigation, are here stated by way of suggestion to any who may be in a position to investigate and may desire to do so.

When at the proper temperature and with complete combustion of fuel, the materials in the kiln are ready to begin combining, they consist of calcium oxide (CaO) magnesium oxide (MgO) Silica (SiO₂) alumina (Al₂O₃) iron sesquioxide (Fe₂O₃) and traces of metallic oxides and salts not essential to the process.

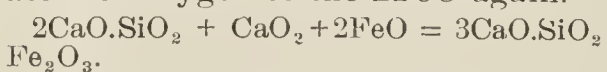
The portion of alumina in combination with the silica is displaced by lime forming 2CaO.SiO₃.

As temperature increases iron sesquioxide appears to give one of its oxygen atoms to the lime, forming calcium dioxide and still further raising the temperature of the clinkering material.

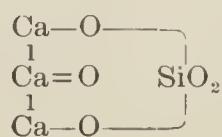


The 2FeO may then combine with free silica to form 2FeO.SiO₂. From which it is in turn displaced by calcium oxide forming again 2CaO.SiO₂ + 2FeO.

At the temperature attained by calcium dioxide it appears to combine with 2CaO.SiO₂ to form 3CaO.SiO₂ at which point it becomes the hard sintered clinker, giving one atom of oxygen to the 2FeO again.



But the CaO thus added to the 2CaO.SiO₂ probably retains its dioxide state in the tricalcium silicate molecule, which may be represented graphically thus:

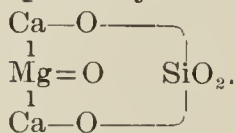


If there be excess of lime present after the completion of this process it will combine with alumina and the sesquioxide of iron will remain inert as at the beginning.

If this hypothesis be correct it would seem that if our friends who are struggling with the magnesia problem can induce the magnesia to form a dioxide more readily than lime at the clinkering temperature, they could substitute it in the cement molecule thus:



or graphically thus:



And if magnesia in this form will hydrate similarly to lime they may produce sound cement with the following composition:

CaO	=	46%
MgO	=	16%
SiO ₂	=	24%
Al ₂ O ₃	=	8%
Fe ₂ O ₃	=	4%
Undet	=	2%

I have seen nothing reported concerning experiments with this composition and have been inclined to the opinion that it would give sound cement of fair quality.

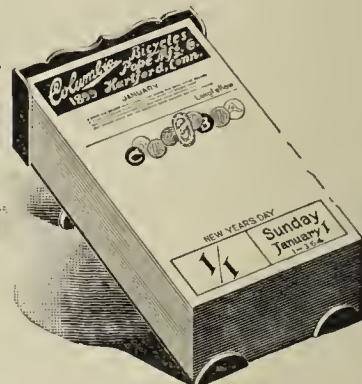
F. W. BROWN.

The Chicago Portland Cement Co.'s plant, now under construction at Oglesby, La Salle county, Ill., is progressing favorably. The storage and office buildings are finished. The kiln building is well under way. All foundations for the remaining building are in as well as most of the foundations for the machinery. Most of the machinery is on the grounds. Everything relating to the construction of the plant is so well in hand, that at the present rate of progress the works will be completed and ready to start up early in January of next year. The raw materials are so favorably located to supply the plant through the winter as well as the summer season.

The illustration shows a heavy canvas tool bag for cement-workers' brick-layers' and plasterers' tools. It is well made and durable, with lock and key, and can be had in the following sizes, 14, 16, 18, 20 and 22 in., carried in stock by the Orr & Lockett Hardware Co., 71 Randolph street, Chicago, who will be pleased to send descriptive circulars, covering the price and description of the bag, together with cement workers' plasterers' and brick-layers' tools of the latest approved styles and shapes.

1899 COLUMBIA MEMORANDUM PAD AND CALENDAR.

The Pope Mfg. Co., of Hartford, Conn., has issued the Columbia Desk-pad Calendar for 1899, supported on a metal stand. This handy reminder has been for years one of the most pleasing of special advertising features. We note that the new calen-



dar is very similar in design and make-up to the 1898 calendar, although it has more artistic covers and is more profusely illustrated. Any person may obtain a copy by applying to the nearest Columbia dealer or by sending five 2-cent stamps to the Calendar Department, Pope Mfg. Co., Hartford, Conn.

HIGH PRAISE FOR THE "CONSTITUTION OF HYDRAULIC CEMENT," BY S. B. & W. B. NEWBERRY.

"No piece of work on the chemistry of cement comparable with this by Messrs. Newberry has appeared within the last ten years, and we congratulate the authors on the sound method, well-directed industry and clear reasoning which are its characteristics."—*The Engineer*, London, Dec. 24, '97.

Copies of this work will be sent to any address on receipt of 25 cents by the CEMENT AND ENGINEERING NEWS.

The Portland cement works at Portway, N. Y., are building additional kilns at the cost of \$1,200 each.

A. J. Werdein of Dansville, N. Y. has the contract for erecting Portland cement kilns at Portway, N. Y.



A NEW GERMAN ARTIFICIAL STONE MANUFACTURERS' ASSOCIATION FORMING.

A call has been issued for a meeting on December 5 and 6 at Berlin, Germany, of the manufacturers of cement ware, artificial stone producers and cement beton builders, with the view of uniting the various interests into a national association. One hundred and seventy firms have so far agreed to attend this meeting. The use of Portland cement in Germany for roof and floor tiles, bridge and house building, statuary, ornaments for interior and exterior decorations calls for millions of barrels of cement yearly and with heavy investment of capital, yielding good dividends. A large corporation in Berlin doing monier and beton construction work declared dividends of over 12 per cent. Our American concrete workers seem slow to take up with this important line of construction and simply stand in their own light in not doing so.

THE JAMES RIVER CEMENT WORKS.

In the beautiful valley of the James River in the heart of the Blue Ridge in Virginia, the works of Messrs. Locher & Co. are situated, where the celebrated brand of natural cement known as the "James River" is manufactured. The mill and mine are at the town of Locher, within a few miles of Balcony Falls at which latter place the first mill for the reduction of the rock was located some years ago, and was operated by water power from the James River. The present mill, built to replace the original, is directly across the river from the mine. On the opposite side are the kilns, and an improved cableway is employed to transport the burnt rock from kiln to mill. It was necessary to locate the mill on the opposite side of the river to render shipment of the cement convenient on the C. & O. R. R., which passes the mill, and on the Norfolk & Western R. R. some distance away. Ample shipping facilities are thus afforded in all directions. The ledge of rock from which the cement is mined is from 8 to 13 feet thick and is reached by a tunnel several hundred feet long, starting at the bottom of the hill, six hundred feet from the south bank of the river. The vein follows the contour of the hill and is inclined at an angle of about 45 deg. at the working face in the tunnel. The face is about 100 feet long, and the inclination of the vein is very favorable to a rapid and easy mining of the rock, for when broken by a shot the material collects at the foot of the incline and

can readily be loaded into the cars which convey it to the kiln close to the bank of the river.

This vein of rock has been worked since 1848, and the best test of the excellence of the cement produced can be found in the masonry of the James River canal built at that date. It was found that the cement mortar was so hard that during the destruction of the old locks the stone fractured in many places while the joints held.

The present mill has a capacity of 300 bbls. per diem.

THE ISTHMUS OF PANAMA; NICARAGUA CANAL ROUTES, ETC., WITH MAPS.

By THOMAS WRIGHT HURST, Chicago.

This is a timely publication in view of the public interest manifested in a trans-isthmusian canal. The author presents a vast mass of valuable fact relating to the various attempts to explore and locate a suitable commercial canal across the great American isthmus and urges that before any appropriation or subsidy by Congress is made to construct the Nicaragua canal a thorough survey should be made across the Isthmus Darien from Caledonia Bay or Port Escosces on the Atlantic to the Gulf of San Miguel on the Pacific via the Savana River, estimated distance for this canal route being only 39 miles as against 169 miles for the Nicaraguan canal now so prominently before the public.

The Darien route possesses good harbors on both sides of the isthmus with a low summit level across the divide. This route has the favorable endorsement of the Baron Von Humboldt. William Patterson, founder of the Bank of England, first conceived the idea of constructing a ship canal across the isthmus at this point in 1698 and planted a Scotch colony with this end in view and was forced to abandon the project under Spanish opposition.

The author gives much clear and valuable information concerning the Nicaragua and Panama canal projects and of the Isthmus generally, all bearing on the general subject of selecting a proper canal route, pointing out and discussing the obstacles and conditions which obtain along and over the various routes now under the public eye. The book can be had through the CEMENT AND ENGINEERING NEWS, Chicago, postpaid, at \$2.00.

Every subscriber should have a substantial binder to preserve copies of The Cement and Engineering News. Price 85 cents, post-paid.

The Bonneville Portland cement Co. of Siegfried, Pa., is undergoing extensive enlargement.

The Michigan Portland cement works, formerly the Coldwater Portland cement works, have started up their plant.

The Clinton Cement Co. of Pittsburgh, Pa. expect to manufacture Portland cement from furnace slag under a new process. Rotary kilns will be used.

The Bronson Portland Cement Co. is running on a restricted output of 500 bbls. per day. Ninety men are on its pay rolls. Enlarged storage capacity is being considered.

The price of cement sidewalks at Rochester, N. Y., let by the city under special assessments in October ranges from 10 to 11 cents per square foot.

All American Portland cement mills report active business and the same difficulty to supply the demand. Prices are very firm at \$2.10 and \$2.35 for American, and \$2.10 and \$2.20 for imported. There is but little of the latter coming in. Rosendale is rather quiet and easy at 65 and 67½c.

The Jeffrey Manufacturing Company of Columbus, Ohio, have recently taken up the manufacture of the Columbian Separator-Screen and Bolter and advise us that they have erected an experimental machine at their works for the testing of such material as may be sent them for that purpose. Parties interested in the screening or separating of cement, cement clinker, ores, phosphate rock, marble, fertilizer materials, bone ash, Plaster Paris, sand, coal, earth, clay, etc. can secure further data and prices by addressing the manufacturers.

The city council of Kankakee, Ill., has decided to have a bridge built to span the Kankakee river. It will be 600 feet long. Alderman Ruehle favors a Melan concrete and structural steel bridge, with fair prospects of having his plans adopted, either in a Melan arch bridge or in some modified plan of Portland cement and structural steel construction. Alderman Ruehle has had a broad experience in bridge construction, having been foreman of bridges over the entire line of the Illinois Central railroad from Sioux City, Iowa to New Orleans, La. This company has for several years been partial to Portland cement concrete for bridge and culvert construction. Contractors desiring information on the subject of the proposed Kankakee bridge can obtain the details by addressing Alderman C. Ruehle, Kankakee, Ill.

HOT WATER TEST FOR CEMENT.

Increasing attention has of late been given to the method of testing the soundness of cement by means of the hot water bath, and this system has much to recommend it, especially in cases in which it is important to ascertain speedily the character of any given sample of Portland. The principle which underlies this plan of testing is that moist heat facilitates and accelerates the induration of cement compounds, and, by the employment of boiling water, the setting process is hastened to such an extent that defects, which might take days, or even weeks, under ordinary circumstances to become manifest, are developed in the course of a few hours. Different observers have suggested somewhat varying methods of carrying out this hot water test, which is undoubtedly a powerful agent for the detection of latent imperfections in the composition or quality of cements of the Portland type. Mr. Margetts, who has used this mode of testing, states that no less than ten samples of cements obtained from various sources became more or less disintegrated by the boiling process; some of them being reduced to mud and losing all traces of cohesion. It has been asserted that forty-eight hours in the hot bath are equivalent to immersion for seven days in cold water, that is to say that a briquette made of neat cement will show a corresponding amount of tensile strength after the above intervals respectively, or that, in the case of tests made with sand, a seven days' hot test is equivalent to a twenty-eight days' cold test; the percentage of difference of the tensile strengths in a good sample of cement being in both instances but trifling. In applying this test to specimens of neat cement, it is usual to make up small circular pats, about 3 inches in diameter, with just enough water to enable them to be smoothed out with the trowel to the thickness of about half an inch in the center, and a quarter of an inch at the edges. As soon as these pats become fairly firm or set, they are placed in water kept at a uniform temperature of about 180° F., or some prefer 212° F. for seven or eight days, after which period, if the pat still remains firm and unaltered, the cement may be pronounced to be sound and of good quality, and capable of undergoing any of the ordinary engineering tests. If the water in the bath is raised to the boiling point, a much shorter period will suffice. If the tests are made with samples of cement and sand, however, the lower temperature should be employed. If used in conjunction with the ordinary tensile

tests, this method should prove of especial importance to the cement manufacturer, who frequently, when making alterations in his material or mixtures, requires to form a speedy conclusion respecting the resultant cement.

Mr. Margetts, in the course of a discussion upon this subject at the Institution of Civil Engineers, in November, 1891, urged the value and importance of this test, and gave the following instance of its application to two cements, nearly identical in their composition, one of which stood the boiling process perfectly, while the second disintegrated after the expiration of three hours in water at 212° F.:

Composition.	No. 1.	No. 2.
Lime.....	60.67	60.47
Silica.....	24.86	24.93
Oxide of iron and alumina.....	12.82	12.42
Magnesia.....	0.63	0.58
Sulphuric anhydride.....	0.36	0.30
Carbonic anhydride.....	0.47	0.52
Alkalies.....	0.73	0.78
Total.....	100.00	100.00
Specific gravity.....	3.11	3.118

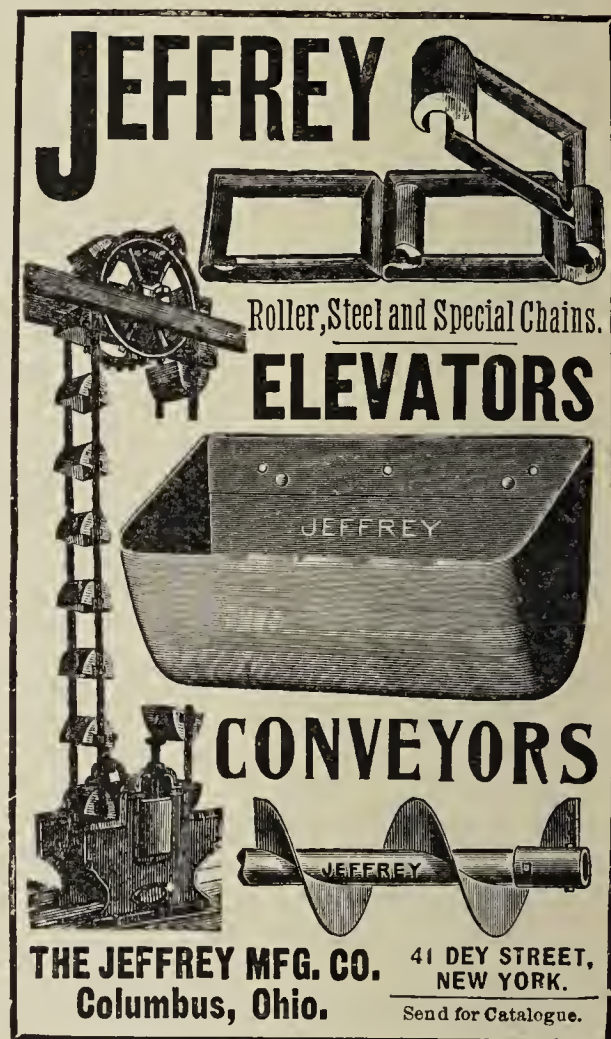
Tested with the sieve, No. 2 proved to be somewhat more finely ground than No. 1, and the average tensile strength of No. 1 after seven days (six days' immersion in cold water) was 496 lbs. per sq. inch. The same cement gave, after twenty-four hours in the air and forty-eight hours in the hot water bath, a tensile strength of 418 lbs. per sq. in. No. 2 cement, tested in the ordinary way at 7 days, had a tensile strength of 390 lbs. per sq. inch, but briquettes exposed for twenty-four hours to the air and then immersed in boiling water became disintegrated, as already stated, in three hours.—G. R. Redgrave.

Imports into the United States of Roman Portland and other hydraulic cements in barrels, sacks or other packages for the year ending June 30, 1898, was 789,575,406 lbs., valued at \$2,549,991.85, upon which a duty of \$631,660.13 was collected at the rate of 8 cents per 100 lbs. or an ad-valorem rate of 24.79 per cent.

Heavy orders continue to come in to all Portland mills, a condition of affairs which has existed for many months past. Notwithstanding the additions to the largest plants in the country, every mill is taxed to its utmost to fill orders. But little imported Portland is now offered, owing to heavy demand in Europe. Prices are naturally firm, but manufacturers have made no advances. Rosendale is moderately active in the local market, but the supply is ample for all requirements.

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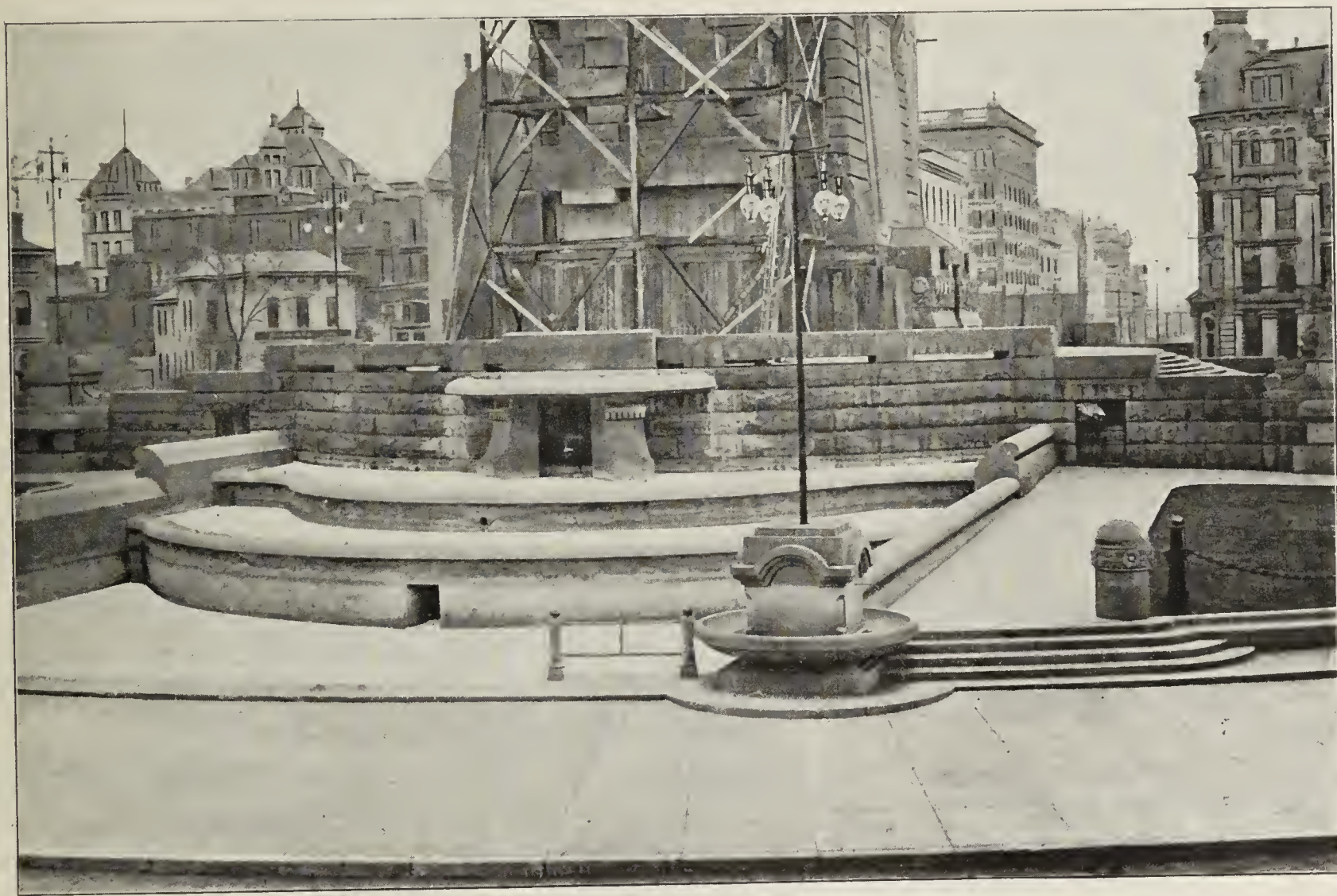
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ENGINEERING NEWS



INDIANA STATE SOLDIERS' AND SAILORS' MONUMENT.

BRUNO SCHMITZ, Architect, Berlin, Germany.

P. A. HAVELICK & CO., Contractors

The cement work around the base of the monument includes the terrace and circle (the latter being 192 feet in diameter) sidewalk and coping. About 5,000 barrels of Lagerdorfer Portland cement were consumed in this work.

HISTORY OF THE PORTLAND CEMENT INDUSTRY IN THE UNITED STATES.

By MR. ROBERT W. LESLEY,
Associate Am. Soc. C. E.

From *The Journal of the Franklin Institute*.

(Continued from November.)

HANDLING OF THE RAW MATERIALS.

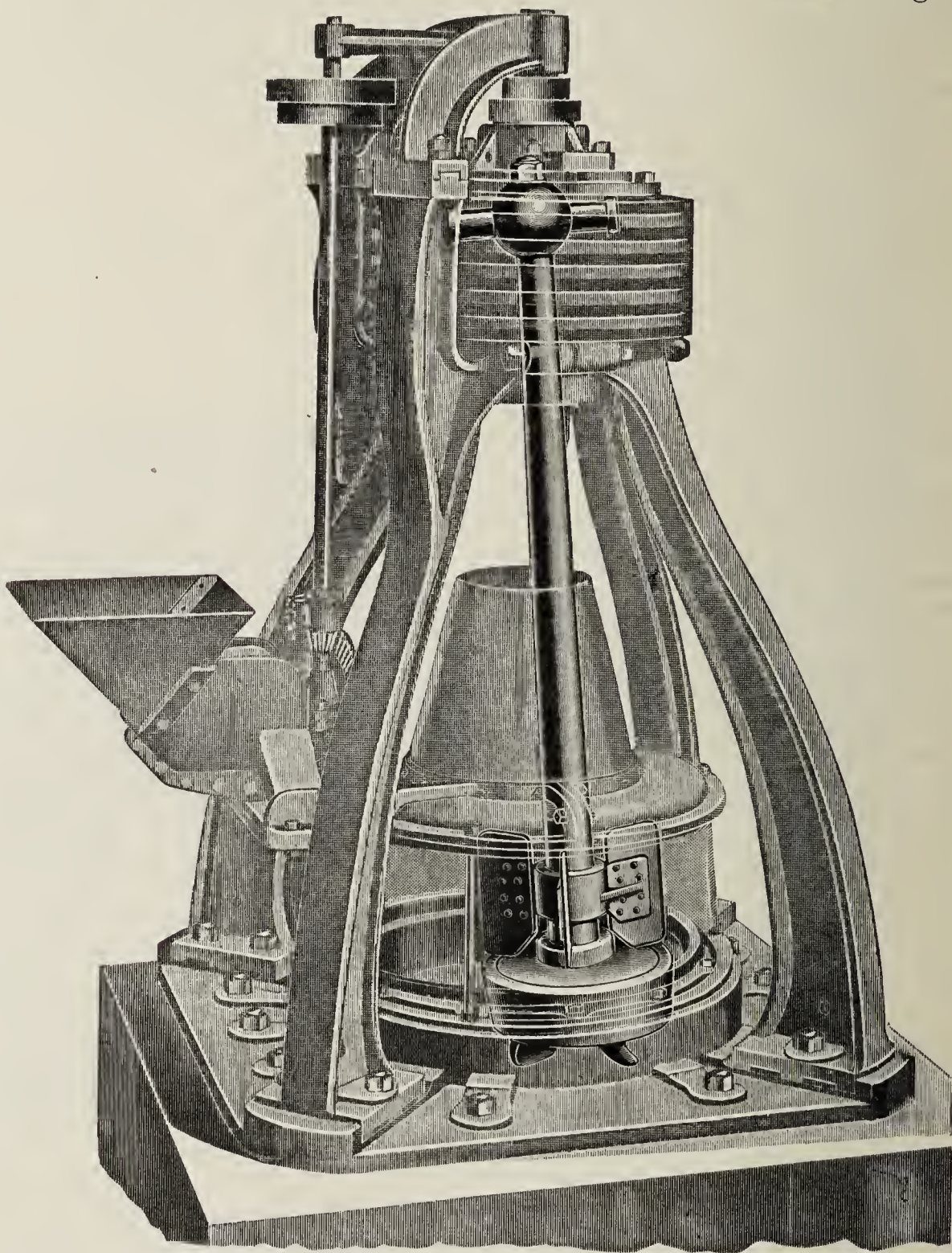
Materials.—Portland cement in England and in Germany, which are the two largest producing countries, may broadly be stated to be the product of an intimate admixture of chalks and clays or marls and clays. The same condition may be stated to govern the industry in France, as most of the large works in that country use material of similar grade. Both of these materials containing large percentages of hygroscopic water, as well as water in mechanical combination, are treated in what is known as the wet way; by this is meant that the making of the composition or slurry out of which the Portland cement is produced, is by the mixing of the two ingredients with a considerable portion of water, and in a large number of European works this percentage of water is so large as to admit of the flowing of the material from place to place in the plant. The production of this intimate mixture of the raw materials in Europe is conducted in pug-mills or slurry-mills of various models, in some cases rollers running over the mixture of clay and chalk and reducing the material to uniform consistency, or in other cases the material to be run through millstones in a wet condition. The material thus reduced was, under the old-time methods in Europe, run into immense settling-basins or vats, covering in some cases many acres, where it was allowed to settle, and where, by evaporation and decantation, it became a mud, showing, after drying, on its surface cracks such as are seen in disused brickyards or pond-bottoms where the water has been drawn away. This material, broken up into lumps according to the cracks formed upon the surface, was brought to drying floors, and, after some few days of drying, was put into a kiln with coke and burned to incipient vitrification, producing clinker, which was subsequently ground to powder and produced the Portland cement of commerce.

Of late years the better practice, which was first instituted in some of the French and better German works, is to more intimately grind the raw materials together, and while in a fluid state to run them into what are called *bassins de dosage*, where a sufficient supply can be held on hand to enable a careful examination to

be made of the chemical constituents of the slurry and from which basins the material is run into other settling-basins, whence it is taken to drying floors, or is pumped into tunnels or on to drying floors forming part of the kilns themselves. As contradistinguished from these processes, which in olden times took several months, and under more modern processes in Europe occupy several days and in some cases several weeks, the American practice has been to use dry materials, such as the hydraulic

clay or wet materials are beginning to run them directly after mixing into *bassins de dosage* and thence into revolving kilns. Thus American practice is enabling mills to manufacture cement by greater economies in handling the raw materials as a primary and most important step.

Kilns.—Following, therefore, upon this step, the next step to be considered in American practice is that of the kilns, the principal distinctly American kiln in its use being the



Griffin Mill.

cement, water limestones and lime-rocks of the Lehigh district, and to treat the material in practically a dry way, grinding it together in the form of powder, which is analyzed, and which powder is subsequently made into bricks by machinery or by hand, as stated in the historical portion of this article. Other works dealing with rocks such as are found at Glens Falls, N. Y., and in the New Jersey district near Phillipsburg, use practically the same methods, while mills dealing with marls and

rotary kiln already mentioned and which is an adaptation of the English Ransome kiln. This form of kiln was never successfully used in England and it remained for the Americans to make a commercial success of it. Many of the works using the dry raw materials, however, are also enabled to successfully meet competition by the use of the dome kilns, such as are used in many of the European works, while others use what are known as the Dietsch and Schoefer continuous kilns both of

which are of German origin, and, while affording economy in coal, seem to entail larger labor cost than the use of the dome kilns. Others, as above stated, using the rock of the Lehigh district and also the marls and clays of the Ohio and Michigan districts, have found means of introducing the raw materials finely ground, into rotary kilns, either in a dry or wet condition. In its course from the receiving end of the kiln the damp powder or slurry is relieved by the heat produced by either oil or pulverized coal from its moisture and carbonic acid gas, until finally the heating power of the kiln further along in its course, clinkers it, and at the discharging end of the kiln the material comes out in the form of small nodules of various sizes and shape and in a clinkered form. This does away with the making of bricks and other forms for the kilns in the case of wet raw material. The forms of these various kilns are very fully described in a new book by Dr. Schoch on the manufacture of cement, published under the auspices of the German Society of Cement Manufacturers, and in a new book by Candlot, Paris, 1897, a thorough description of which burning apparatus would involve considerable in the way of illustration and in technical explanation.

Mills and Crushing Machinery.—Another material point of the difference between the American and European methods, and one to which the very great advance in the product of this country is due, is in the mechanical apparatus for grinding. European practice has been very largely based upon precedents. The precedents for mills were water power and the line shaft for driving mills was usually connected with a water-wheel, and mills were in turn connected with the line shaft by bevels or other forms of cog gearing. Thus the mills in many European works are situated in the second story of the buildings, losing considerable space, and the grinding apparatus in use are the well-known forms of millstones, varying in size from 3 to 6 ft. in diameter. In many of the more advanced European plants mills are now driven directly by belts from line-shaft belt, thus taking the place of the old-fashioned cog-gearing, and in several of the more modern mills what are known as tube-mills are being used, the apparatus consisting of a revolving cylinder containing a large number of Iceland pebbles. Into this cylinder the clinker is introduced, and, by the revolution of the cylinder and agitation of the pebbles, the material is ground to almost impalpable fineness. Early in the history of the Lehigh district

in this country, millstones directly driven by belts and encased in iron frames marked an advance in American grinding methods. This was followed by the introduction in this and other districts of the Sturtevant, Frisbie-Leukop and other forms of iron and steel grinding apparatus, doing away with millstones. Another improvement in American grinding apparatus in this country dates possibly to the introduction of the Griffin mills by the works of the American Cement Company, at Egypt, Pa., somewhere about 1887. This mill is now largely in use in cement works in this country and abroad, its introduction in European works being very extensive during the past two or three years. The apparatus, as shown by the cut is very simple in construction, and to it and the other mills is due much of the reputation American cement has, of late years, for its extreme fineness and sand-carrying qualities. American Gates crushers and coffee-mill crushers have also shown their superiority, according to the best reports, over similar machinery used in Europe, and in this line the modern works here seem fully equal, if not superior to many of the leading European works, so far as crushing machinery goes. Having thus noted the differences in the handling of the raw materials, in kilns and crushing machinery, between American and European works making Portland cement, it is next of importance to examine the American raw materials, and to note that, notwithstanding their variation in many cases from the raw materials of Europe, that American Portland cement produced from these comes up, in both *chemical analysis* and *standard tests*, to the highest grade of the old established brands of Germany, France and England.

AMERICAN RAW MATERIALS.

In the United States raw materials for Portland cement may be said to be very numerous and quite varied. The principal of all the deposits, and the one from which the largest amount of cement is turned out, may be said to be that of the Lehigh hydraulic limestones, above stated, which are found on either side of the Lehigh river, at or around Coplay, and which extend for a considerable distance, and are found further down across the Delaware, near Phillipsburg, N. J. These rocks are laminated water lime rocks, and by reason of their chemical composition, as well as their structural character are specially adapted to the manufacture of Portland cement. They form a part of what is known as the Silurian argillaceous limestones, a formation which also forms cement rocks for

many of the other cement districts. The Glens Falls cement, which is made at Glens Falls, N. Y., is made from a lime rock of the Silurian formation, together with clay or clay rock found in the same vicinity. In New York state, at and around Jordan, Warners and Wayland, the principal ingredient is the white marl of the Silurian formation, while similar materials are also used in the manufacture of cement in the Michigan and Ohio districts. Further west, at San Antonio, Tex., White Springs, Ark., and Yankton, S. D., Portland cement is made from the cretaceous rocks which are found outcropping at various points there and throughout a large territory in the middle West. These, with clay, produce excellent cement.

Grouped according to districts and the raw material found therein, the American Portland cement industry may be said to embrace:

(1) The Lehigh district, with total product, according to the figures for 1897, of 1,640,000 barrels, or nearly 75 per cent. of the total output of the country. It extends along the Lehigh river from Siegfried, Pa., to Phillipsburg, N. J., and includes the four mills of the American Cement Company at Egypt; the two mills of the Coplay Cement Company at Coplay; the two mills of the Atlas Cement Company at Coplay and Northampton; the mill of the Hercules Rock Lock and Bonnville Companies at Whitehall and Siegfried, and the mills of the Alpha and Vulcanite Companies, near Whittaker, N. J.

(2) The New York district, embracing the marl and clay raw material plants of the Empire and American Cement Companies, at Warners and Jordan, and the Wayland and the Whittemore, Rauber & Vicinus Works, near Wayland. In addition to these is the Glens Falls (N. Y.) Portland Cement Works, using rock materials.

(3) The Ohio district, including works at Sandusky and Castalia, O., operated by companies of the same name, and using marls and clays, while rock materials are used by the Diamond Cement Company at Middle Branch.

(4) The South Dakota district, with the works of the Yankton Portland Cement Company, using a species of chalk and clay.

The following table from the "Mineral Industry of the United States," Vol. VI. gives the latest figures on the production of the various districts. The Michigan district uses marl and clay, and several works are going into operation there, among them the Bronson and the Peerless; the Arkansas district is limited to a single works, at Chalk Cliffs; the

Illinois, to a single works, near Chicago, which was recently burnt down; the Texas region to one works, near Salt Lake, also recently burnt, and the California to two small works at San Diego and Colton respectively:

(In Barrels of 400 Pounds.)

STATES.	1896.			1897		
	Barrels.	VALUE AT WORKS.		Barrels.	VALUE AT WORKS.	
		Total.	Per Barrel.		Total	Per Barrel
California	8,985	\$17,970	\$2 00	17,060	\$51,180	\$3 00
New Jersey	270,858	400,999	1 48	440,454	641,421	1 45
New York	266,482	445,594	1 67	361,594	592,676	1 64
Ohio	163,182	320,364	1 96	147,332	291,640	1 98
Pennsylvania	825,000	1,225,000	1 49	1,200,000	1,740,000	1 45
South Dakota	23,776	47,552	2 00	39,900	75,8 0	1 90
Texas	15,000	38,000	2 53	7,778	19 912	2 56
Other States (a)	4,000	7,000	1 75	58,453	108,850	1 86
Total barrels	1,577,283	\$2,502,479	\$1 59	2,272,971	\$3,521,489	\$1 55

(a) Includes Arkansas, Illinois, Michigan and Utah.

(To be continued.)

A CONCRETE COMPANY ASSIGNS.

The Manhattan Concrete Co. of New York city has made an assignment to Henry L. Fridenberg. Liabilities \$60,000, with large assets. The company was incorporated on December 17, 1895, with a capital stock of \$50,000 to lay concrete floors, foundations, etc. The original name of the company was the Aberthaw Construction Company and the name was changed to the present style two years ago. The assignment was caused by liens being filed on its contracts on various operations which prevented the company getting its money out of them to meet maturing obligations.

Send in your subscription for the CEMENT AND ENGINEERING NEWS.

FACTS FOR INVESTORS IN PORTLAND CEMENT ENTERPRISES.

The air is full of glittering and golden opportunities, promulgated by smooth and oily promoters inviting the susceptible investor to yield up his money in exchange for bonds and stocks in new Portland cement enterprises, in all denominations from \$10 up.

The two main cries and bases of arguments of these schemers are, first, great shortage in production of Portland cement in this country, and the great profits to be derived, and being derived by manufacturers of Portland cement.

After careful investigation there is no question of doubt but that all cement manufacturers, with the exception of three or four companies in the Lehigh valley district, have up to this time manufactured cement

without one cent of profit to themselves.

In answer to the first argument, a careful investigation proves that there was probably a shortage in this country during the summer of 1898 of not to exceed 500,000 barrels. Assuming that the demand for Portland cement is to largely increase, the following table of actual outputs of existing mills in the year 1898, and the year 1899, will prove immediately whether or not this shortage has not been provided for, and will not much more than supply any possible increased demand. The following table gives quite accurately the total product manufactured during the year 1898, and the second table almost as closely gives the output already assured for 1899. The reader can readily see that increased demand will be very much more than met, and prices must go down-grade materially by reason of the necessary competition in the effort to dispose of the increased amount. Look out then for the bursting of the bubbles:

PORTLAND CEMENT MANUFACTURED IN THE YEAR 1898.

	bbls. per day.	bbls. per annum.
Empire Cement Co.,	400	144,000
Atlas Cement Co.,	3,000	1,080,000
Alpha Cement Co.,	1,500	540,000
Vulcanite Cement Co.,	700	252,000
Saylor's Cement Co.,	700	252,000
American Cement Co.,	1,000	360,000
Bonneville Cement Co.,	500	180,000
Siegfried Cement Co.,	300	108,000
Glens Falls Cement Co.,	500	180,000
Wayland Cement Co.,	500	180,000
Genessee Cement Co.,	300	108,000
New York Cement Co.,	300	108,000
Buckeye Cement Co.,	200	72,000
Sandusky Cement Co.,	400	144,000
Art Portland Cement Co.,	200	72,000
Bronson Cement Co.,	300	108,000
Yankton Cement Co.,	300	108,000
	11,100	3,996,000

PORTLAND CEMENT TO BE MANUFACTURED IN THE YEAR 1899.

	bbls. per day.	bbls. per annum.
Empire Cement Co.,	400	144,000
Atlas Cement Co.,	5,000	1,800,000
Alpha Cement Co.,	2,500	900,000
Vulcanite Cement Co.,	1,700	613,000
Saylor's Cement Co.,	1,800	648,000
American Cement Co.,	1,000	360,000
Bonneville Cement Co.,	500	180,000
Siegfried Cement Co.,	300	108,000
Glens Falls Cement Co.,	1,000	360,000
Wayland Cement Co.,	500	180,000
Genessee Cement Co.,	500	180,000
New York Cement Co.,	600	216,000
Buckeye Cement Co.,	200	72,000
Sandusky Cement Co.,	400	144,000
Art Portland Cement Co.,	300	108,000
Bronson Cement Co.,	1,000	360,000
Yankton Cement Co.,	600	216,000
*Lehigh Cement Co.,	1,000	360,000
*Diamond Cement Co.,	500	180,000
*Castalia Cement Co.,	500	180,000
*Lawrence Cement Co.,	1,000	360,000
*Michigan Cement Co.,	500	180,000
*Chicago Port. Cement Co.,	750	270,000
*Marquette Cement Co.,	300	108,000
*LaSalle Port. Cem. Co.,	500	180,000
*Wallaceton Cement Co.,	200	72,000
	23,550	8,479,000

* Factories just completed, or that will be complete by the early part of 1899.

Increased output of 1899 over 1898, 4,483,000 bbls.

The above tables very closely represent the actual outputs of Portland cement in this country for the years 1898 and 1899. There are still many mills that are struggling to formulate schemes by which they can erect themselves and enter the arena, and in the light of the above facts it is certainly safe to predict that prices for Portland cement will within two years be reduced forty per cent from the present market prices. The promoters will be wise enough to unload before that time. STATICIAN.

NEW METHOD OF DEPOSITING CONCRETE.

In an address, before the Cement Manufacturers' Association held at Vienna, by Attilo Rella, C. E., on the "Application of Cement in Modern Construction of Buildings and Engineering Works," he says:

"There has been some radical changes in the manner of depositing concrete under water in the formation of walls, foundations and dykes. Heretofore concrete has been laid in horizontal layers, while now the better practice is to commence and build up the work to the height of the water level at one point on the work so as to develop a sloping face from the top of the mass to the foundation and then continue depositing the concrete from the high-point, or water level and permit it to gradually descend along the sloping face under the action of gravity and thus distribute itself as it may, driving and displacing the water before it as the work advances."

CEMENT AND ENGINEERING NEWS.

(PUBLISHED MONTHLY)

WILLIAM SEAFERT, Editor and Publisher.

OFFICE—161 LA SALLE STREET.

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Chicago, December, 1898.

CORRESPONDENCE.

We solicit correspondence on all matters of general interest to the cement trade in all of its branches. Engineering notes, public improvements, and facts and opinions drawn from practical experience will be welcome.

MACHINE MIXED CONCRETE.

The one noticeable event in concrete masonry construction is that engineers are beginning to specify machine-mixed concrete especially in government work and in large private undertakings.

The engineers of the Chicago Drainage Canal specify machine-mixed concrete, with a provision for hand-mixing under certain definite conditions. It may be mixed by hand on some form of solid floor, but not otherwise. Machine-mixed concrete has several advantages not possessed by hand-mixed concrete.

First, machine-mixed concrete is more thoroughly done and in less time. It is more uniform and more economical, and consequently the built-up work will show up more uniform, from beginning to the finish, that is to say there will be little or no difference in the color, one section will blend and harmonize with the other.

Then again a given amount of cement will cover a greater amount of aggregate in the machine-mixed concrete than is possible by hand-mixing and it would be good practice to call for a greater percentage of cement with a given quantity of aggregate where the mixing is done by hand over the machine-mixed concrete. Carefully conducted experi-

ments show that 20 per cent. less cement can be used in machine-mixed concrete than is necessary in hand-mixing. The machine-mixed concrete will be of equal strength with the hand-mixed, having 20 per cent. more cement. This means that four barrels of cement in the machine-mixed concrete will go as far as five barrels used in hand-mixed concrete. Where these conditions are better understood the practice of machine-mixed concrete must come into more general use.

Finely ground cement is essential to produce the favorable results indicated in comparing hand-mixed with machine-mixed concrete, where the cement is coarsely ground the economy of machine-mixed over the hand-mixed will disappear. The tendency of American Portland cement mills now is to finer grinding, and any advance in this line will enlarge the sphere of usefulness of the concrete mixing machine.

OBITUARY.

James G. Lindsley, superintendent of the Newark Lime and Cement Manufacturing Company, died at Kingston, N. Y., December 4th, aged eighty years. He represented the seventeenth congressional district, consisting of Ulster, Green and Delaware counties, New York, in 1884. He was president of the old village of Roundout when it and Kingston were merged into the city of Kingston, in 1872, and became its first mayor. He was well known as a geologist.

BALTIMORE LIME AND CEMENT EXCHANGE BANQUET.

The annual banquet of the Baltimore Lime and Cement Exchange occurred at Hotel Lexington, December 8th, Charles H. Classen, presiding.

The menu cards were unique and consisted of tiles 2½x5 inches in size, upon which the bill of fare was printed in colors, and will be preserved by the guests present as souvenirs.

Those present were Charles H. Classen, Benjamin Wallis, Harry P. Boyd, William A. Allers, Charles T. Cockey, Jr., Addison H. Clark, Clinton M. Johnson, Samuel J. Diggs, H. R. Grimes, T. J. Warren, J. T. Flautt, John T. Benson, Henry Clark, R. S. Green, T. M. Dinsmore, R. H. Diggs, John J. Kelly, J. C. Doyle, L. F. Johnson, John S. Bullock, W. C. Dittmar and E. D. Miller.

Addresses were made by Charles H. Classen, president of the Exchange; Harry P. Boyd, who acted as toastmaster; Benjamin Wallis, secretary; E. D. Miller, of the Builders' Exchange; John J. Kelly, J. C. Doyle and others.

The committee of arrangements consisted of H. P. Boyd, Charles T. Cockey, Jr., and J. T. Flautt. Prior to the banquet a business meeting was held, at which the question of the Home Product Exposition was taken up and referred to a committee consisting of Harry P. Boyd and H. R. Grimes to take such action in regard to an appropriation for the project as they may deem best. The officers of the Exchange, which was organized in 1896, are; President, Charles H. Classen; Vice-President, Benjamin Wallis; Secretary, H. P. Boyd and Treasurer, William A. Allers.

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IMPORTS OF CEMENT INTO THE UNITED STATES.

WHERE FROM.	OCTOBER.				TEN MONTHS ENDING OCTOBER.			
	1897.		1898.		1897.		1898.	
	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.
United Kingdom....	16,344,200	54,689	20,595,711	75,899	109,931,143	359,123	79,498,452	278,921
Belgium.....	28,727,366	87,839	21,329,710	65,872	174,572,179	512,321	227,107,434	678,767
France.....	761,297	2,366	297,600	1,199	14,337,575	42,088	2,962,400	11,293
Germany.....	36,281,398	120,323	36,733,077	119,607	389,216,921	1,282,006	337,026,696	1,136,079
All Other Europe ...	1,388,900	4,484	2,896,938	7,932	14,787,800	53,037	19,901,670	61,178
British North Am....	172,575	846	201,100	1,004	1,517,974	7,234	1,569,050	7,564
Other Countries.....	.....	.....	.....	.....	411	1	5,200	67
TOTAL.....	83,675,736	270,547	82,054,136	271,513	704,364,003	2,255,810	668,070,902	2,173,869
Domestic Exports of Cements, bbls.	6,374	9,505	4,273	9,452	87,183	81,672	30,823	61,458

There were 2,681,064 lbs. of imported Roman and Portland cements, etc., in the United States bonded warehouses on October 31, 1898, valued at \$8,591 against 6,759,284 lbs., valued at \$20,692, in October, 1897. Imports of asphaltum or bitumen for October, 1897, were 4,246 tons valued at \$14,547; October, 1898—5,891 tons valued at \$10,963. For ten months ending, October 1897, 107,688 tons valued at \$370,537; for ten months ending October, 1898—65,028 tons valued at \$159,444.

TULLOCH & CO.'S MONTHLY MARKET REPORT.

The undiminished active demand recorded in our Trade report, issued last August, continues, and there is at present no lessening in the eagerness on the part of consumers to cover themselves for their future supplies.

The London mills continue to report inability to accept fresh orders, calling for prompt delivery, and it is now more than evident that we shall carry over to 1899 a large volume of demand remaining at present unsatisfied.

In the case of many works, practically, export trade is for the time being abandoned, owing to the heavy

we estimate that quite three-fifths of the increased earnings of the mills are swallowed up in additional expenses of manufacture, owing to higher costs of fuel, labor, etc.

Another point, we wish to put forward, is that this increase in demand is not due to foreign but home consumption, where the actual visible requirements for 1899 can be more exactly estimated. Exports to foreign markets show a decline, *vide* following statistics:

Total exports from United Kingdom ports for ten months ended 31st October:

1896.....	305,845 tons.
1897.....	338,386 "
1878.....	284,274 "

gards Continental consumption generally, the higher prices demanded by the works are unlikely to have any effect in diminishing demand.

The German export trade continues brisk, as the following figures tend to show:

Total exports, January to September, 1897, 369,664 tons; total exports January to September, 1898, 382,299 tons.

The enterprise of the German mills in not allowing their hold on foreign markets to lessen by reason of more remunerative prices obtainable for consumption in Germany is shown by the increasing exports during the past six months to such markets as the U. S. A., Australasia, South Africa, Brazil, and China, where the



MARKET STREET, BLUFFTON, IND.

Four Miles Combined Curb and Gutter under construction using Lagerdofer Portland Cement.

BUNTON, SHRYER & MCGANNON, Contractors.

domestic demand keeping their full production employed for the home consumption.

Many buyers have put the question to us, "will present heavy demand continue during 1899 to such an extent as will enable the mills to hold up prices to current level?" A close estimate of the probable demand and supply for next year—after making every allowance for the probable increase in production on the part of the London mills—enables us to reply distinctly in the affirmative.

Were the present advance in prices asked by the makers representing all profit, doubts might be expressed as to their ability to maintain rates, but

During the last few months demand has been brisker for India, South Africa, and Canada, but otherwise the larger consuming markets have remained quiet.

We quote best brand of London Portland cement 7s. to 7s. 6d., according to delivery required.

In Germany, both seaboard and inland works continue oversold. The eagerness of exporters and home consumers to cover themselves for their requirements during 1899 confirms a general opinion that trade next year will remain equally brisk. The works generally are shy of committing themselves to contracts unless prices offered are distinctly tempting. It is evident that, as re-

trade has been won, not by any undue cutting of prices, but by sheer merits of quality.

First-class brands, such as "Alsen," "Hemmoor," and "Germania," are quoted M.7.50 to M.8 f.o.b., according to quantity and delivery required.

In Belgium makers are united in calling for higher rates and are quoting for forward deliveries 6d. to 9d. per barrel advance in price.

Inasmuch as the larger buyers and exporters have already entered into contracts with many works at these advanced rates for 1899, undoubtedly the Belgian mills occupy a very strong position. Specially is this the case with those works producing high grade artificial Portland cement

but at the same time all works producing high grade Natural Portland cement are well sold for next year at high rates, and, speaking approximately, we are of opinion that quite half of the estimated total production of the works is already sold for the next twelve months.

Total exports of Belgian cement, from January to the end of September this year, amounts to 292,691 tons, as compared with 232,751 tons for the same period in 1897.

In passing, it is worth noting that this year up to the end of September over 40,000 tons of Belgian cement had been imported for local consumption in Great Britain. It is a strong endorsement of the quality of the cement that many of the leading con-

eign markets are waking up to the fact that more money must be paid to replace stocks, and whilst political uncertainty does not induce confidence, there has been more disposition to purchase. Certainly there is no sign of any weakening in the general position of demand; but, on the contrary, every assurance that the present prosperous condition of the trade will make itself even more felt during next year.

4 Fenchurch ave., London, E. C.
November 25th, 1898.

CONCRETE AND CEMENT SPECIFICATIONS.

The following concrete and cement

Sand—The sand used shall be coarse, clean and sharp, free from all clay loam or gravel, and shall be well screened and of a quality approved by the chief engineer.

Mortar—When Portland cement mortar is used for beds and joints, it shall be mixed in proportion of one (1) part of cement to three (3) parts of sand. When used for pointing, it shall be mixed in proportion of one (1) part cement and (1) part sand.

Portland Cement Concrete—Concrete shall be made in the proportion of one (1) part of cement, three (3) parts of sand and six (6) parts of broken stone. It shall be mixed by machinery, if so directed by the engineer, or if mixed by hand, it shall be done upon a suitable plat-



View of Market Street, Bluffton, Ind., showing cement sidewalks under construction using Lagerdorfer Portland cement.

tractors in this country are unhesitatingly buying Belgian in competition with London Portland. Both for municipal purposes and for public works the cement is found satisfactory, and in London, where the specifications are fairly strict, there have been considerable quantities employed for ordinary building and municipal work—a striking reply to many engineers abroad, who, possibly through not being acquainted with the merits of this grade of cement, decline to sanction its use on best class work.

We quote leading brands of artificial cements 6s. 6d. to 6s. 9d. f.o.b. Antwerp, and first quality natural cements at 5s. 3d. f.o.b.

In conclusion it is evident that for-

specifications for the substructure of the eight-track rolling lift bridge, Sherzer type, crossing the main channel of the sanitary district, near 31st street, Chicago.

Cement—The best Portland cement shall be used on this work, brand and quality to be subject to the approval of the chief engineer. The weight per cubic foot of Portland cement shall be not less than one hundred (100) pounds. The development of tensile strength for Portland cement shall be not less than four hundred (400) pounds per square inch, after being exposed one (1) day in air and six (6) days in water. All lumpy, dirty or damaged cement shall be rejected; also damaged or short weight packages.

form. Care must be taken to first thoroughly mix the dry cement and sand; after which stone shall be added, together with a proper amount of water, all to be thoroughly mixed; water to be applied by a sprinkling-pot; on being placed, the concrete shall have a wetness such as to permit quaking or mobility likened to liver. The stone for concrete shall be of a quality approved by the engineer, broken into angular pieces of a size small enough to pass through a ring two (2) inches in diameter, and be entirely free from dust, sand, dirt and any foreign substance. The stone must be thoroughly drenched with clear water before mixing with the mortar.

The concrete shall be deposited in

layers not to exceed six (6) inches in thickness, as directed by the engineer, and to be thoroughly tamped or rammed.

THE SEWALL CEMENT ARCH CONDUIT.

In the distribution of electrical energy in large cities for light, power and telephone service, underground conduits are constructed in the principal thoroughfares. These conduits have, in the past, been more or less imperfect in the various details of

manhole to secure proper drainage and to avoid depression on the floor surface. The individual arches (Fig. 3) properly hardened and thoroughly wetted are now placed upon the prepared floor under a templet to give them absolutely uniform positions. The first set of arches being in place other arches are set end to end under a templet. A wire cloth cover with a medial strip of cotton cloth is set over and anchored into the concrete over the joints, preventing any sifting of cement into the conduit area.

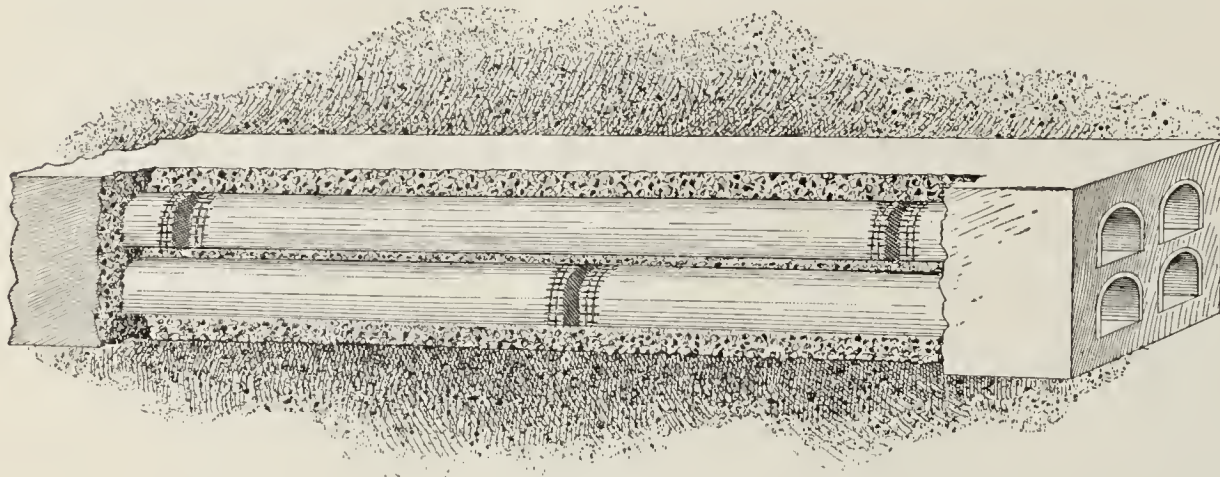


FIG. 1.

construction and especially so in the failure to produce a smooth and uniformly even floor for each individual duct, through which the electric conductor is drawn and rests.

We illustrate the Sewall system of underground conduit construction which embodies all that can be desired for a perfect conduit service for electrical distribution and consists of a series of individual cement arches laid upon a perfectly smooth Portland cement concrete floor and covered with concrete which is again prepared for a second floor for the reception of the second series of cement arches as hereinafter more minutely described.

The key to the entire system is the individual cement arch shown in Fig. 3. This is molded true to size required and is composed of equal parts Portland cement and sand, strengthened by a metal cloth made from wire .035 inch diameter woven with a mesh $\frac{3}{8}$ in. square. The arch requires seven days after molding to harden. It is generally 3 ins. high and 3 wide at base and center (inside measurement.) The shell can be 3-16 in. or $\frac{3}{8}$ in. thick and weigh from 2 to 3 lbs. per ft. respectively. It is very strong; the lighter one is capable of bearing a heavy man without perceptible effect.

When a conduit is to be constructed the trench is excavated to the required depth and foundation composed of Portland cement concrete laid, properly tamped and troweled smooth under a top dressing of dry cement, the grade, pitch or plane receiving careful attention from manhole to

As soon as the first tier is in position it is immediately covered in with concrete and a second floor made for the reception of a second tier of arches. As it is not necessary to wait for the cement to set the process can be indefinitely continued until the whole structure is completed and the soil and paving replaced. Within two or three weeks the arches will have set firmly to the structural concrete, forming a monolithic mass having several tiers of perfectly smooth, continuous and unbroken ducts extending from manhole to manhole with perfect drainage and ready for the reception of the lead covered cables.

The underground conduits now in common and extensive use are made up of short lengths of vitrified clay tiles, which in the process of vitrification are more or less blistered and required to be scraped to prevent injuring the cable covering, this leaves the interior somewhat rough and more or less injures the cable in drawing it into place and at the same time calls for more strength to draw the cable into place.

All burned tile ducts carry the defects of producing rough and uneven joints, it being impossible to produce accurate alignment, being weak at the joints, with innumerable depressions along the duct floors, affording convenient lodgment for sewage, water and ice, very injurious

to the cable coverings.

Provisions are made for enveloping the conduit with an insulating material such as bituminous concrete, as shown in Fig. 2. Fig. 1 is a side end view of a four duct conduit with a part of the structural concrete removed to indicate position of duct arches. Fig 2 is a cross section view of a 12-duct conduit in position. Fig. 3 is a detail of the cement arch. Figs. 4, 5, 6 and 7 show fittings for making curves. Full particulars relating to this system of cement arch conduit construction can be had by addressing C. F. Sewall, 825 Monadnock Block, Chicago.

HISTORY OF THE SPANISH-AMERICAN WAR, WITH HANDY ATLAS MAPS AND FULL DESCRIPTION OF RECENTLY ACQUIRED UNITED STATES TERRITORY.

The above is the title of a work, which the Lawrenceville Cement Co., 26 Courtlandt street, New York, has published for gratuitous distribution to its customers. It contains a carefully prepared history of the Spanish-American war, commencing with the 21st day of April and notes the principal facts occurring day by day up to August 20, noting the fall of Manila. There are 8 full page maps 14 by 11 inches, with marginal cross indexes by letters and figures, showing the Philippine Islands, Hawaii Islands, the Greater Antilles, Cuba, Hayti, Puerto Rico and Jamaica, a full page map of Puerto Rico, the Pacific Coast from Alaska to California, with special marginal maps of the country between Juneau and Fort Selkirk and Alaska, the Klondike

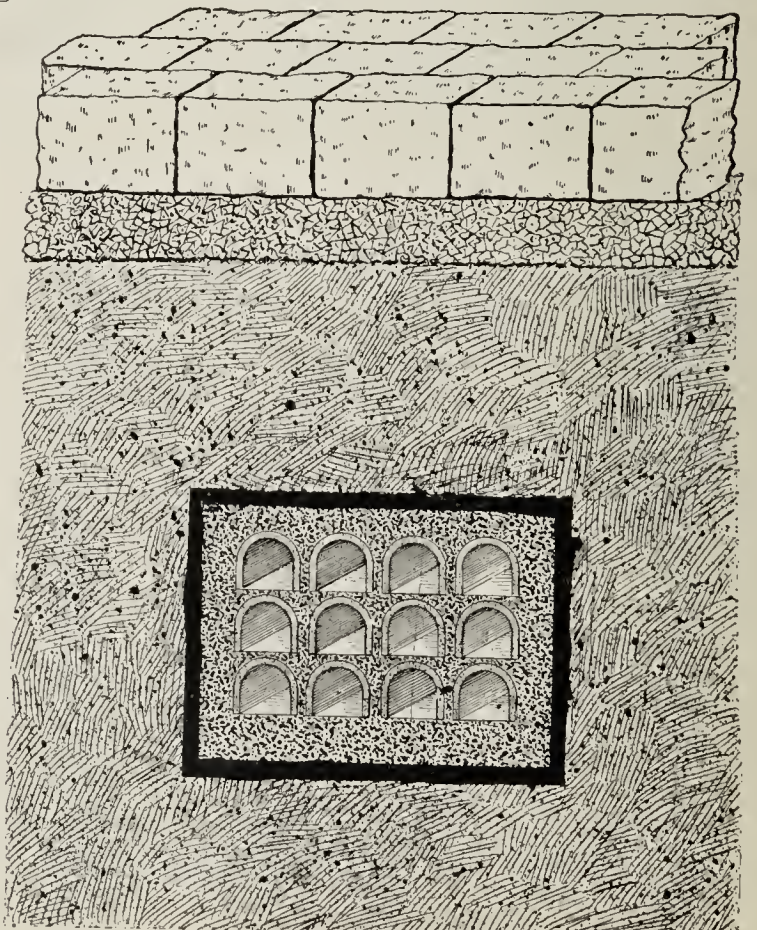
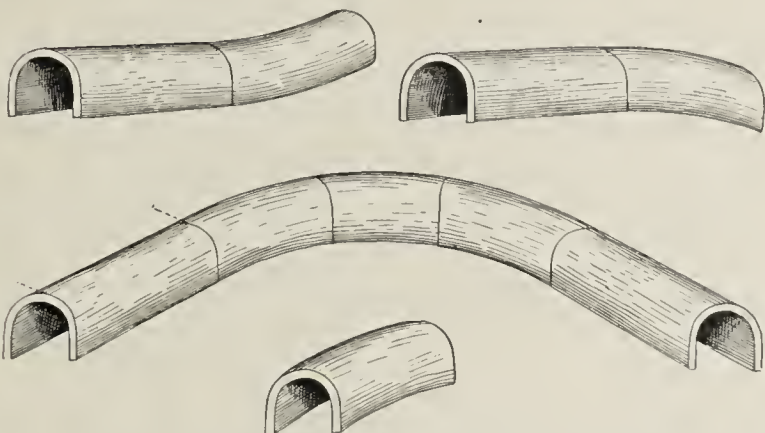


FIG. 2.



FIG. 3.



FIGS. 4, 5, 6, 7.

Regions and a double page map of the world, with portraits of the principle naval and military officials, prominent in the war, with a condensed history of the Philippine Islands, its commerce, production and people, and a like description of Hawaii, Puerto Rico and Alaska. There is no advertising matter except on the outside cover pages, and this advertising matter simply notes the various points along the Atlantic coast line in which Beach's Rosendale Cement enters into the construction of fortifications from Maine to Texas.

ARTIFICIAL STONE PAVING.

The following specification will be found suitable for laying artificial stone paving in most any locality, and of a superior quality:

1. The pavement and foundation will be 20 inches in thickness, as follows: The wearing surface, with concrete base, will be 4 inches in thickness, and perfectly homogeneous. The foundation will be 16 inches in depth.

2. The space over which the pavement is to be laid will be excavated to a depth of 20 inches below the top surface of the pavement when completed. Any objectionable or unsuitable material below the bed will be removed and the space properly filled and well rammed. This excavation will be filled with sharp, hard, clean cinders (preferred) or broken stone, thoroughly puddled, rammed and trimmed, so as to be exactly parallel to the surface of the finished pavement.

3. Upon the foundation thus prepared will be laid a concrete or base 4 inches in thickness, to be made as follows: One measure of imported Portland cement, subject to a prescribed test, will be incorporated

with three measures of sharp sand, free from earthy or vegetable matter, in a dry state. After the sand and cement have been mixed by turning two times, it shall be passed through, by throwing against a standing sieve, and then made into a mortar with the least possible amount of water. Cubically broken hard stone, samples of fractured portions to be submitted, that will pass through a two and one-half inch and one and one-half inch ring respectively, thoroughly cleaned from dirt, drenched with water, containing no loose water in the heap, will then be incorporated immediately with the mortar in the proportion of two measures of the smaller and three measures of the largest stone. Each batch of concrete will be thoroughly mixed and evenly spread on the foundation, between well secured limits or mold guides and compacted by ramming until the total depth has been reduced one inch. The concrete when compacted and in position will be one inch at every point below the top surface. All cutting or jointing to be done immediately.

4. All mixed concrete, not in position, standing over one hour will be rejected. Concrete not topped the same day as when laid will be removed. All future materials must be transported on planks in order to protect the concrete.

5. Upon the concrete or base will be laid the wearing surface, or pavement proper, one inch in thickness, composed of the same or equal brand of cement as specified for the base, compounded with two measures of sharp, coarse white sand, or finely crushed granite, free from flour and dust, preferred. These aggregates will be thoroughly mixed by turning two times and then being thrown through a standing sieve and then wet to the consistency of a stiff mortar. This mortar will be evenly ap-

plied to the surface of the base or concrete, and rammed down solidly. After supplying the surface with additional mortar, it shall be evenly and smoothly finished by troweling. When it is necessary to use a dryer, two parts cement, one part fine, sharp flint sand. This dryer, after dusting over the surface, shall be thoroughly floated in before finishing.

6. All joints shall be cut through to the corresponding joints in the concrete or base, and be well turned back to prevent chipping.—WARNER H. JENKINS, C. E., in *Municipal Engineering*.

NEW CATALOGUE.

The Jeffrey Manufacturing Company of Columbus, Ohio, U. S. A., have issued a new catalogue of 224 pages, covering chain belting and steel cable elevating and conveying machinery, with illustrations of almost every device manufactured by them, showing machinery assembled and installed used in coal mining, quarrying, and in numerous manufacturing enterprises. The individual parts or pieces of the various kinds of machinery and apparatus manufactured are shown, together with a new line of specialties just added to their already large line, namely spiral conveyors, with standard and interchangeable parts, with lists and tables giving price per ft., size and capacity per hour; the New Jeffrey-Century Belt Conveyor System, for handling of ores, broken stone and sand, using rubber and cloth belts.

Cement manufacturers will be specially interested in the Jeffrey-Columbian Separator, Bolter and Screener, for screening cement, lime, marl, etc. The claims made for this separator are that it will make a clean separation and yield a product working on Portland cement, of which more than 95 per cent will pass 100-mesh, with a capacity of from 15 to 20 tons per hour. The catalogue is a credit to the Jeffrey Co. and will be appreciated by the manufacturing interests which have use for this class of machinery.

The Michigan Portland Cement Co. have purchased 100 acres of marl lands near Quincy, Michigan. This brings the company's holding in this vicinity up to 400 acres of marl land.

The Coldwater Portland Cement Co. has changed its name to the American Construction Co. This is simply using the charter for a new company. The business of the Coldwater Portland Cement Co. has been merged into the Michigan Portland Cement Co., so far as it related to the manufacture of Portland Cement.

CONCRETE IRON VIADUCT AT SANTA MONICA, CAL.

It has been said that the solidity, wealth and prosperity of a community is to be judged by the character of its public improvements. It may be added that substantial bridges are an index of the progressive spirit and intelligence of the people who project such structures. We are able to present this week a perspective sketch of a proposed concrete iron bridge or viaduct, which is to be built on Ocean avenue, Santa Monica, Cal. This handsome street, running parallel with the ocean for miles, and a short distance back from the crest of the bluff, is the main

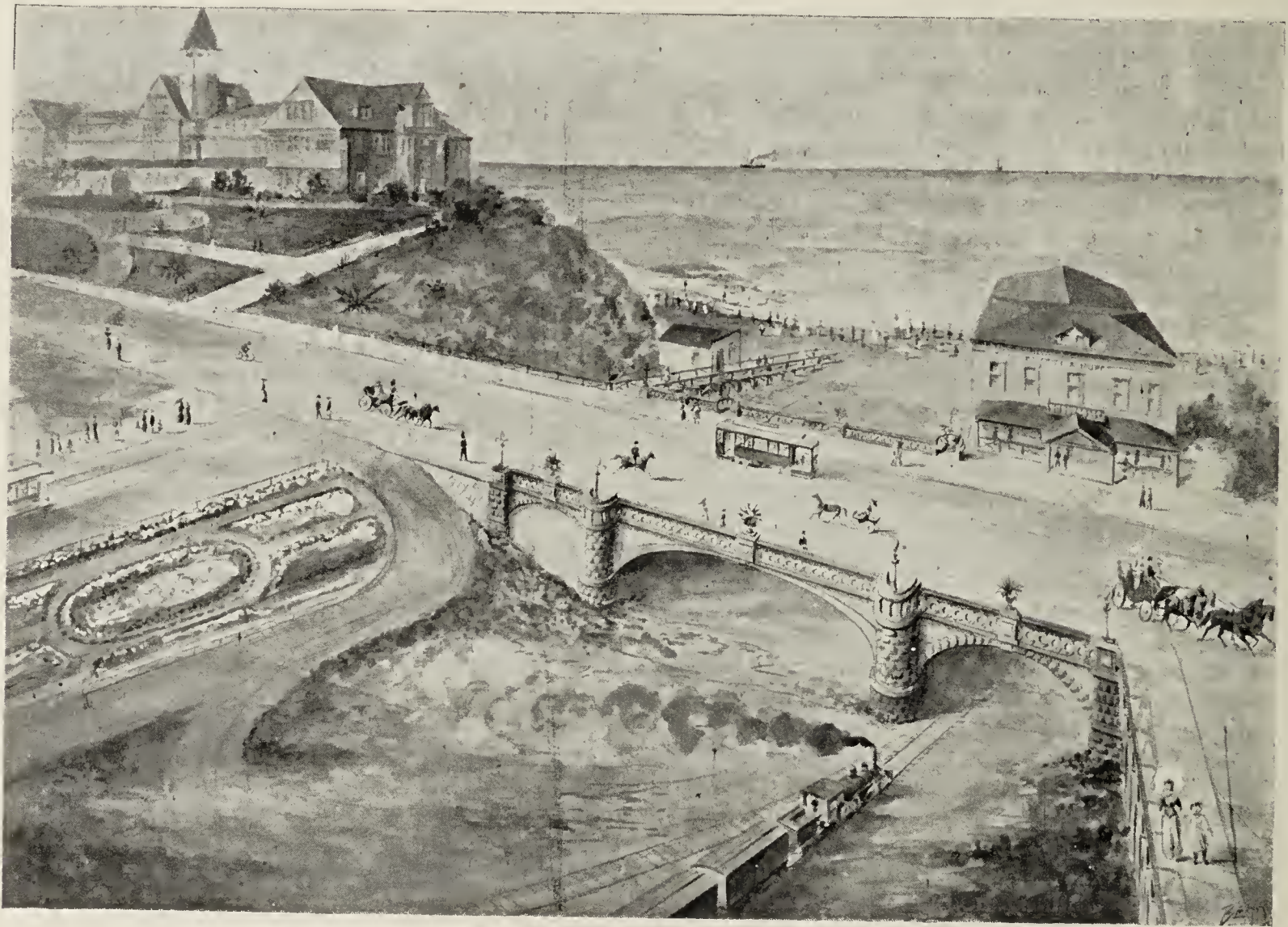
of cement is broadcast. The award of the prize was made on the recommendation of Mr. Jas. D. Schuyler, M. Assn. Soc. Civil Engineers, to whom the plans were submitted by the trustees for an analytical report on their respective merits.

Mr. Jas. S. Merritt, of Merritt & Co., the Philadelphia branch of the Expanded Fireproof Construction Co., starts on an extended trip through Europe to investigate the art of concrete construction as practiced abroad, especially when combined with steel structural forms. We wish Mr. Merritt a pleasant and successful journey.

CONDITIONS IN DAWSON CITY.

Dawson City has made rapid strides during the past month in the way of building improvements. In July, only two large warehouses were here. Four more are now nearing completion, all operating their own steamers.

There will be no lack of provisions and merchandise here this winter. The large amount of supplies being brought in has had a tendency to reduce prices on a few commodities. A 50-pound sack of flour which brought \$8 last month is now sold for \$5. It is to be hoped that the price of hotel accommodations will be reduced, as none but the wealthy can enjoy hotel life at present, at



The accepted first prize design for a concrete viaduct to be built on Ocean Avenue, Santa Monica, California. The design was submitted by C. Leonardt, 438 Bryan Block, Los Angeles, Cal.

thoroughfare of that charming seaside resort, 16 miles distant from Los Angeles. At one point it is intersected by a ravine, which breaks its continuity and requires to be spanned by a bridge. The structure shown in the illustration was the design recently accepted by the trustees of the town of Santa Monica and awarded first prize in an open competition in which some twelve designs were submitted. It is to be of concrete-iron, with a center span of 80 ft., and a width of 100 ft. It has exceedingly graceful lines, and when built will be the pride of the community. The design was submitted by C. Leonardt, whose reputation as a concrete worker and manufacturer

HIGH PRAISE FOR THE "CONSTITUTION OF HYDRAULIC CEMENT."

BY S. B. & W. B. NEWBERRY.

"No piece of work on the chemistry of cement comparable with this by Messrs. Newberry has appeared within the last ten years, and we congratulate the authors on the sound method, well-directed industry and clear reasoning which are its characteristics."—*The Engineer*, London, Dec. 24, '97.

Copies of this work will be sent to any address on receipt of 25 cents by the CEMENT AND ENGINEERING NEWS.

Cement and Engineering News \$2 per annum.

\$6.50 per night for a room with a mixture of husks and straw for a bed, a candle for light, and board at the rate of \$12 per day. There are a few cheaper houses but accommodations are still poorer. The number of log cabins is being increased rapidly, for in a couple of weeks it will be too cold to sleep in tents. Log cabins can be rented for \$50 a month and upward, according to location and distance from the center of the town. Typhoid fever has been on the increase lately and many deaths have resulted. It will decrease as soon as the ground is frozen, about the 1st of October.

Hundreds of Americans have gone down the river to Alaskan territory,

where it is predicted more gold will be found than in the Northwest Territory. Forty-mile creek, which enters into the Yukon river 52 miles below Dawson City, is said to be good on the Alaskan side. Eagle City, 50 miles below, is said to be in a position to rival Dawson City in another year; and as a base of supplies it will be much more convenient, being inside the boundary line. Eagle City is the name now given to what is marked Belle Isle on the map of the United States Coast and Geodetic Survey of the Yukon river. The territory for hundreds of miles around Eagle City is said to be very rich.

The future of Dawson City greatly depends on new discoveries being made this coming winter. There is no doubt of a great deal of gold being in this district within 100 mile radius but it has yet to be prospected. The cost of taking food up to the mining camps and the price of labor make it very expensive to work the claims, and they must be very good in order to pay.

J. C. McCook,
U. S. Consul.

DAWSON CITY.

The city of Macon, Ga., is constructing a number of large reservoirs in connection with the city water service. The inside of these reservoirs are finished with Portland cement.

The Brier Hill Iron and Coal Co., Youngstown, O., have erected a new cement plant to be devoted to the manufacture of cement from furnace slag, with a capacity of from 200 to 300 bbls. per day.

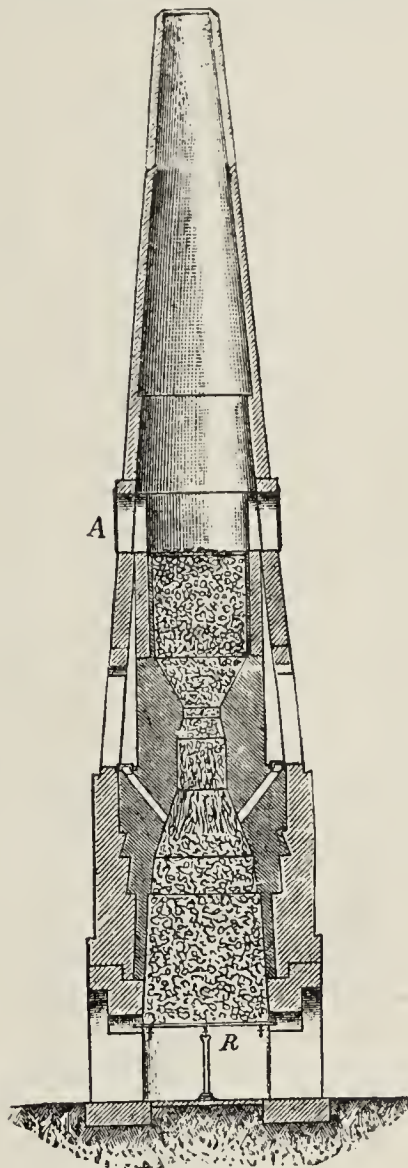
In 1896 the production of cement in Michigan aggregated 4,000 bbls., having a value of \$7,000. In 1897 the product rose to 15,000 bbls., with a value of \$26,250, an increase of nearly 300 per cent. The product for 1898 will reach 50,000 bbls.

City Engineer Charles P. Chase of Clinton, Iowa, has been directed by ordinance of the city to prepare plans for a new public park, bordering the Mississippi river front, from Third avenue to Sixth avenue, covering an area of about fifteen acres.

The Michigan Portland Cement Co. has filed a mortgage lien in favor of the Central Trust Co., of New York, trustee, for the purpose of facilitating a proposed issue of bonds not to exceed \$1,000,000. The bonds will be in \$500 sums, drawing 6 per cent interest and payable January 1, 1919. The mortgage covers all the lands and other property of the company located in Bethlehem and Coldwater townships, Branch county, Michigan.

THE AALBORG IMPROVED SCHOER KILN.

The cut shows the Aalborg improved Schoer continuous kiln for burning Portland cement clinker. This kiln is extensively used in European cement works, where it is favorably known for the excellent quality of cement clinker produced, the average of rejection of unburned clinker, not exceeding 2 per cent. on a fair average of the output. The



kiln yields from 60 to 90 barrels of cement per day, consuming 22.5 kilograms (about 48 lbs.) coal per bbl. of finished cement, no coke being required. The operation of the kiln is continuous, the raw material and fuel being fed in above and the clinker drawn through the bottom. F. L. Smidth & Co., 66 Maiden Lane, New York are the agents for the United States.

The Michigan Portland Cement Co. have contracted for a new steel factory building, 80x350 ft. as an addition to their plant at Coldwater, Mich. The material is to be delivered on the grounds before March 1, next. The cost of the improvement will exceed \$100,000. The extension will be pushed to rapid completion.

Every subscriber should have a substantial binder to preserve copies of The Cement and Engineering News. Price 85 cents, post-paid.

ILLUMINATING GAS FROM SLAG.

The New York Times announces that a new illuminating gas can be made from furnace slag, having all the good properties of acetylene gas and yet superior to acetylene and is known as ethylene gas. The commercial product is known as carbolite. To produce carbolite, slag, while molten, is poured into converters, such as are used for the manufacture of Bessemer steel, and pulverized coke is blown through the liquid mass by means of the air blast. Next the melted slag, thoroughly permeated by the pulverized coke, is subjected to electric treatment by means of which the slag is fused with the coke. Then the mass is poured off into molds and allowed to cool, after which it is boxed and becomes carbolite in a commercial form. One of the inventor's claims is that this material will produce a gas superior to acetylene at much less cost.

WHEN WRITING TO ADVERTISERS
PLEASE MENTION THIS PAPER.

NEW YORK BOARD OF HEALTH AND ASPHALT PAVEMENTS.

The health authorities of the city of New York declare that asphalt paved streets breed disease and especially the "Grip." An opinion from such a source must work serious injury to the paving industry.

Asphalt pavements are, as a rule, more easily kept clean and wholesome than either brick, stone or wood pavements and we can scarcely credit the statement that they result in breeding disease more than other forms of pavements.

The Chicago health authorities flatly contradict the idea that asphalt paved streets do produce the "Grip," and we are inclined to side with the Chicago health authorities. While it is true that street refuse and sweepings, permitted to remain on asphalt streets, injures and destroys the surface and causes rapid deterioration, leaving cuts and depressions, especially in the gutters where the street sweepings usually collect. This objection has been entirely remedied by substituting the combined curb and gutter made of Portland cement concrete, which carries the sweeping without injury to its surface for indefinite periods.

An advertisement in CEMENT AND ENGINEERING NEWS brings reward.

ON SALE.—"The Hydraulic Index of the Chatilier Formulas," by S. B. Newberry; and "The Commercial Analysis of Portland Cement," by W. B. Newberry; under one cover. Ready July 10, '98. By mail 25 cents. Address, Cement and Engineering News, 161 La Salle Street, Chicago.

OIL FIND IN MISSOURI.

Mineral oil in large quantities has just been discovered near Braymer, Mo., a station on the Cedar Rapids & Kansas City division of the Chicago, Milwaukee & St. Paul road. Luis Jackson, industrial commissioner of the company, says that the parties who made the find have quietly taken oil leases covering 20,000 acres of land, embracing a territory ten miles in length and six miles wide and they are now endeavoring to interest eastern capital in developing their property.

Judging from surface indications, boring will result in a great production. The country around Braymer resembles the moderate hilly sections of Pennsylvania. A thick black substance like congealed molasses has been found on the surface of the water in wells in this district and analysis has shown it to be a mineral oil with asphaltum base, technically known as "Maltha."

The analysts' reports show that the maltha contains about 25 per cent. of asphaltum proper and that the indications are that petroleum and gas will be found at an increased depth. Many of the drinking wells in the district are said to be tainted with an oily taste. A maltha flow in California produced last year 13,000 tons, the product realizing from \$15 to \$18 a ton. The greater part of it was used for street-paving purposes.

The geological formation of the country around Braymer is said to indicate oil and gas, particularly in the territory southwest of that point. Oil and gas, Mr. Jackson says, have actually been discovered in paying quantities about 200 miles southwest of Braymer. There is already a petroleum refinery employing 200 men at Neodesha, Kas., and gas has been found within the last two months at Fort Scott, Kas., while at Iola, in the same state, a lead and zinc melting plant is being operated with natural gas as fuel.

While some people are inclined to be incredulous as to the value of these discoveries at Braymer, the industrial commissioner suggests that as nothing is discovered until it is discovered the whole question can be easily settled by sinking wells at a cost of anywhere from \$6,000 to \$10,000. The capitalist who does this may find after sinking the well that he is so much out of pocket, or he may find himself on the high road to fortune.

Some years ago coal was reported to exist in the country traversed by the Kansas City division of the St. Paul road, especially at the northern end of the division, near Ottumwa, Iowa. Everybody began to dig for coal. Few found it, but they, in most

instances developed valuable mines. Mystic, Iowa, on that division of the road, is now the seat of a large coal mining industry, and there are several other points in the same district with good coal mines. The St. Paul road now hauls an immense amount of coal every year from mines along the Cedar Rapids & Kansas City division to the markets of Iowa, Minnesota and South Dakota.

INDUSTRIAL MAP OF THE CHICAGO, MILWAUKEE & ST. PAUL RAILWAY.

The Chicago, Milwaukee & St. Paul Railway has issued a pocket industrial map showing locations for industries along the line of its road, specially designating the presence of copper, iron, timber, lead, zinc, coal and oilfields subject to further development. The map can be obtained by writing to Luis Jackson, Industrial Commissioner, C. M. & St. P. Ry., Old Colony Bldg., Chicago, Ill.

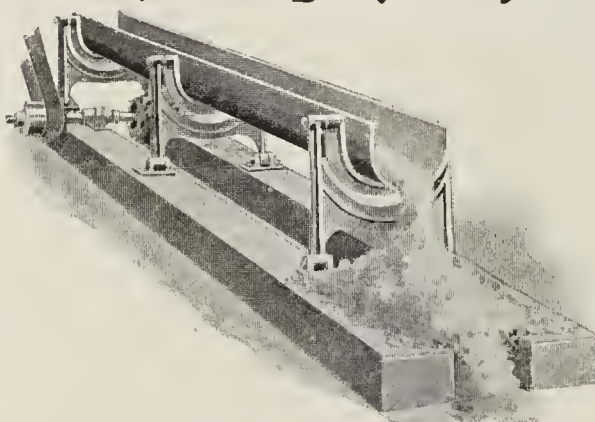
MARL LANDS FOR SALE.

WE HAVE FOR SALE A LARGE DEPOSIT OF MARL for the manufacture of cement. This deposit is located a short distance from deep water where the largest vessels can load and the lowest freight rates can be obtained to all lake points for the shipment of marl or cement. There is also on the land a quantity of hardwood timber for barrels or charcoal which will be sold with the land if desired. The deposit has been thoroughly tested and shows 96 per cent carbonate of lime. For particulars address

W. D. HITCHCOCK,
Detour, Mich.

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THE
CONSTITUTION OF
HYDRAULIC
CEMENTS



BY SPENCER B. NEWBERRY
AND W. B. NEWBERRY.

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Price (in paper covers) 25 Cents.

Sent to any address, postpaid, on receipt of price.

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161 La Salle Street, CHICAGO

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— AND —

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Vol. V, No. 6.

CHICAGO, DECEMBER, 1898.

Price, 25 Cents

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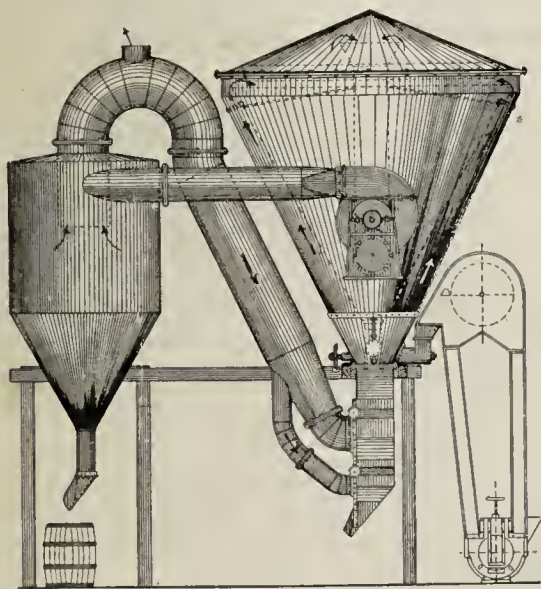
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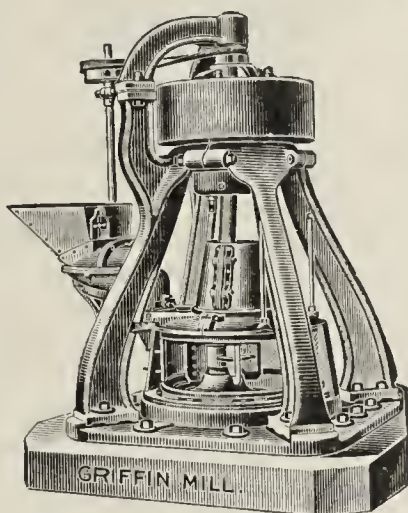
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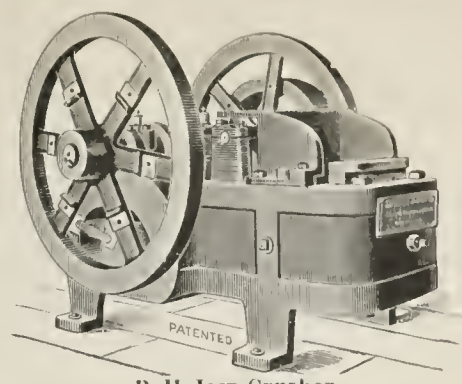
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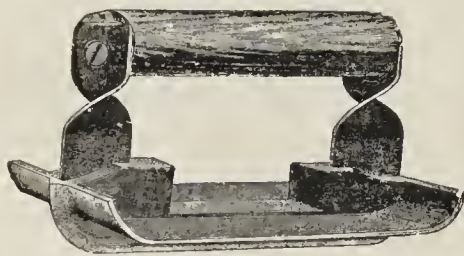
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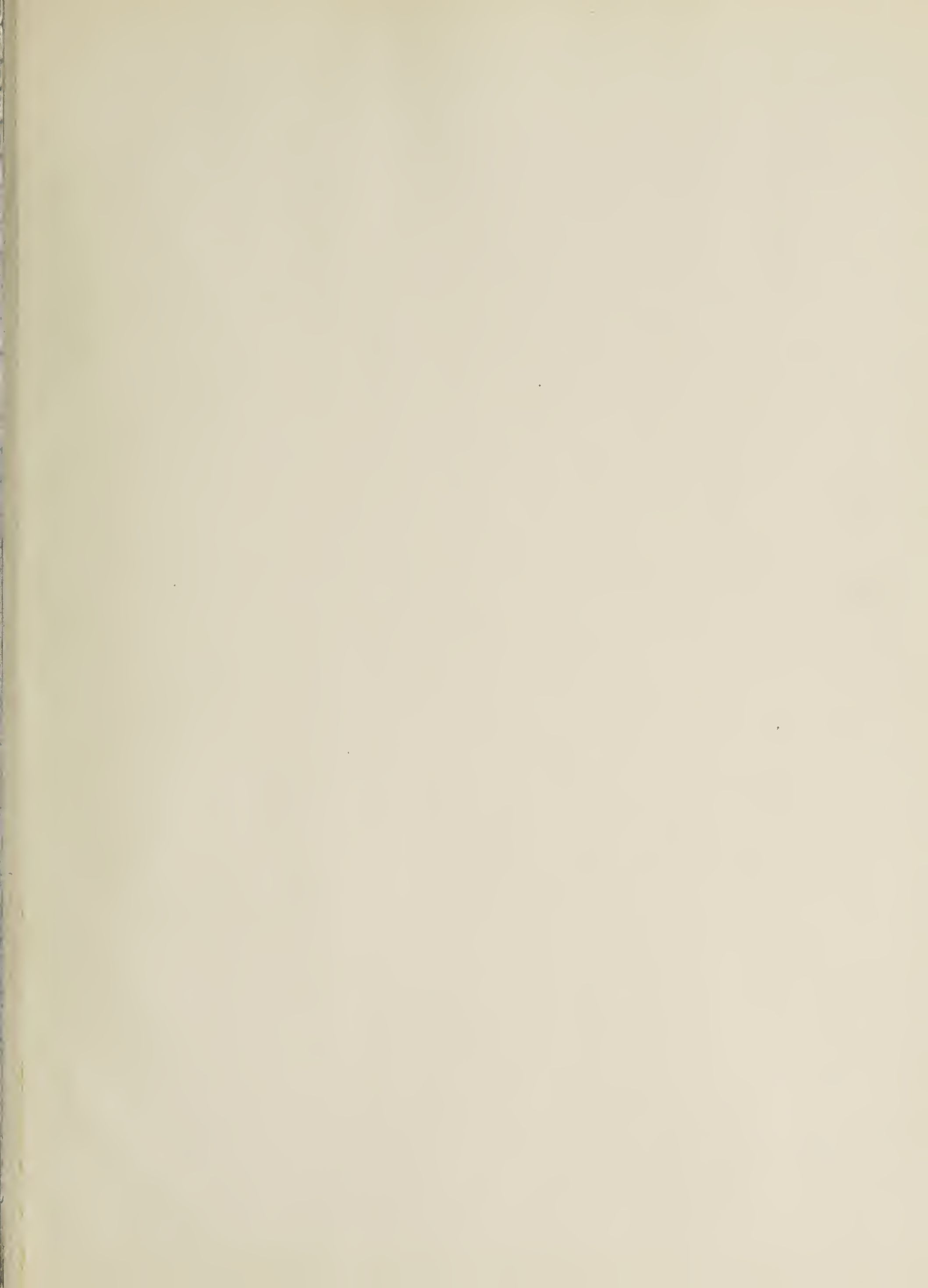
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